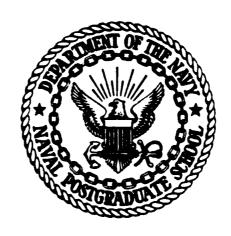


MICROCOPY RESOLUTION TEST CHART NATIONAL BUREAU OF STANDARDS-1963-A

MA 123582

# NAVAL POSTGRADUATE SCHOOL Monterey, California



CALIFORNIA COASTAL OFFSHORE TRANSPORT AND DIFFUSION EXPERIMENTS - METEOROLOGICAL CONDITIONS AND DATA

G. E. Schacher, D. E. Spiel, C. W. Fairall, K. L. Davidson, C. A. Leonard and C. H. Reheis

> Environmental Physics Group Naval Postgraduate School Monterey, California

> > 06 December 1982

Approved for public release: distribution unlimited

Prepared for: Outer Continental Shelf Office Minerals Management Service Los Angeles, California 90017

る。当時に

## NAVAL POSTGRADUATE SCHOOL Monterey, California

Rear Admiral J. J. Ekelund Superintendent

David A. Schrady Provost

The work reported herein was supported in part by the Naval Ocean Systems Center, San Diego, California.

Reproduction of all or part of this report is authorized.

This report was prepared by:

Professor of Physics

BDM Corporation Contract Employee

Contract Number N00014-82-0-0251

BDM Corporation Contract Employee

Contract Number N00014-82-0-0251

K. L. DAVIDSON

Professor of Meteorology

Research Technician, Meteorology Department

Environmental Scientist. Energy Resources Company

Reviewed by:

Dean of Research

Professor Chairman, Department of Physics

SECURITY CLASSIFICATION OF THIS PAGE (When Date Entered)

REPORT DOCUMENTATION PAGE	BEFORE COMPLETING FORM				
	3. RECIPIENT'S CATALOG NUMBER				
NPS 61-82-007 ADTA $[2350]$	2				
4. TITLE (and Subtitle)	5. TYPE OF REPORT & PERIOD COVERED				
California Coastal Offshore Transport and					
Diffusion Experiment - Meteorological Conditions	Technical Report				
and Data	6. PERFORMING ORG. REPORT NUMBER				
7. Author(a)	8. CONTRACT OR GRANT NUMBER(s)				
G.E. Schacher, D.E. Spiel <sup>1</sup> , C.W. Fairall <sup>1</sup> , K.L.	o. con that or other homoches				
Davidson, C.A. Leonard and C.H. Reheis <sup>2</sup>					
bavidson, C.A. Leonard and C.H. Reners					
9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS				
Naval Postgraduate School	62759N; SF59551697				
Monterey, CA 93940	N6600182WR00017				
11. CONTROLLING OFFICE NAME AND ADDRESS Outer Continental Shelf Office	12. REPORT DATE				
Minerals Management Service	9/1/82				
1340 W. 6th St.	TO NUMBER OF PROSE				
Los Angeles, CA 90017 14. MONITORING AGENCY NAME & ADDRESS(II different from Controlling Office)	15. SECURITY CLASS. (of this report)				
	Unclassified				
	154, DECLASSIFICATION/DOWNGRADING SCHEDULE				
Approved for public release: distribution unlimited					
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)					
18. SUPPLEMENTARY NOTES					
	N00014/92 0 0253				
<ol> <li>BDM Contract Employee Contract Number</li> <li>ERCO, La Jolla, CA</li> </ol>	N00014-82-0-0251				
4. ERGO, Let JULIA, GR					
19. KEY WORDS (Continue on reverse side if necessary and identify by block number)					
Overwater Transport	•				
Coastal Meteorology					
Marine Boundary Laver					
Diffusion					
20. ABSTRACT (Continue on reverse side if necessary and identify by block mumber)					
Four series of tracer experiments have been performed to parameterize an overwater-coastal transport and diffusion model. The experiment were carried out in the winter and summer near Ventura, CA and Pismo Beach, CA. The tracer gas SF, was released from the research ship RV/Acania, which also collected and extensive amount of overwater meteorological data. This report contains descriptions of all experiments, the overwater meteorological data, and calculated meteorological parameters that are needed to characterize the transport and diffusion.					

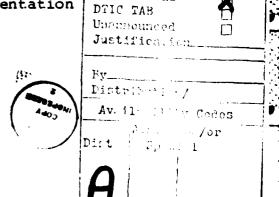
DD | FORM 1473 | 1473 | (Page 1)

EDITION OF 1 NOV 68 IS OBSOLETE

Unclassified

#### TABLE OF CONTENTS

- I. Introduction
- II. General Descriptions
- II-1. Participants
- II-2. Description of Experiments
- II-3. Description of Localities
  - A. Ventura
  - B. Pismo Beach
  - C. California Coast Seasonal Climatology
  - D. Wind Climatology
- II-4. Test Periods Weather Descriptions
  - A. Synoptic Conditions
  - B. Local Conditions
- II-5. RV/Acania Equipment
  - A. Sensors and Their Locations
  - B. Data Acquisition and Recording
- II-6. SF<sub>6</sub> Gas Release, Equipment and Rates
- III. Data Reduction Methods
  - A. Bulk Aerodynamic Method
  - B. Turbulence Method
  - C. Convective Mixing Velocity
- IV. Data and Results
  - A. Gas Release Locations and Times
- IV-1. Wind Histories
- IV-2. Acoustic Sounder
- IV-3. Radiosonde Profiles and Mixed Layer Parameters
- IV-4. Meteorological Data and Calculated Parameters
- IV-5. Wind Direction Variance
- IV-6. Ship Movements and Relative Winds
- Appendix A. Calibration of Shipboard Instrumentation
- Appendix B. Synoptic Charts



Accession For

NTIS GRA&I

#### LIST OF FIGURES

- Figure 1. Locations of the van, boat, and aircraft routes and ground level sampling for the September 1980 and January 1981 tracer experiments near Ventura, California.
- Figure 2. Locations of the van, and aircraft routes and ground level sampling for the December 1981 and June 1982 tracer experiments off Pismo Beach, California.
- Figure 3. Chart of the area surrounding Ventura, site of the BLM-1 and 2 tracer experiments.
- Figure 4. Chart of the area surrounding Pismo Beach, site of the BLM-3 and 4 tracer experiments.
- Figure 5. Average wind speed and direction as a function of the time of day and time of year. The solid lines are wind speed isopleths (knots), the dashed lines indicate wind direction (north is at the figure top), and land and sea-breeze regimes are approximately divided by the heavy broken line.
- Figure 6. Surface wind roses for Point Mugu for each month.
- Figure 7. Surface wind roses for Vandenberg.
- Figure 3. Side view of the RV/Acania showing the location of the meteorological sensors.
- Figure 9. Heated manifold for release of SF6 gas.
- Figures 10. Wind histories as measured on the RV/Acania.

  The figures are labeled: "10 (cruise number-date)."

Figures 11. Acoustic sounder strip chart recordings from the RV/Acania. The boundary layer depth, as determined by radiosonde, is shown by a small black or white dot, indicated by an R at the bottom of the chart.

The figures are labeled: "11 (cruise number-dates)".

Figures 12. Radiosonde profiles and mixed layer parameter profiles (potential temperature and water vapor mixing ratio) from RV/Acania releases. The figures are labeled: "12a or b (cruise number-date)". a is for the radiosonde data and b for the mixed layer parameters.

#### LIST OF TABLES

- Table 1. Participants in the BLM series of experiments and their responsibilities.
- Table 2. Monthly averages of the most frequently observed wind direction, percent of time the wind speed is greater than 21 knots, and the number of days of Santa Ana winds per month. The maximum number is the maximum observed over a ten year period.
- Table 3. Meteorological measurements made aboard the RV/Acania and the equipment used.
- Table 4. Flow characteristics of the  $SF_6$  gas releases for the four BLM experiments.
- Table 5. Locations and start and end times for tracer gas releases. Times are Pacific Local.
- Table 6. Heights from which acoustic echos were observed from the acoustic sounder.
- Table 7. Boundary layer depths as determined from radiosondes.
- Table 8. Measured and calculated meteorological parameters.
- Table 9. One-hour average wind directions and wind direction variances.
- Table 10. One-half hour average relative wind directions.

#### I. Introduction

The Minerals Management Service (formeraly the Bureau of Land Management) has supported a series of experiments to obtain emperical data needed to parameterize EPA-approved, Gaussian and trajectory dispersion models for the California coastal regions. The model is to be used by Federal, state, and local regulatory agencies to assess the onshore impact of material released into the atmosphere in the outer continental shelf area as the result of the development of offshore oil and gas activities. Four experiments have been performed to date, two in the Santa Barbara Channel, near Ventura, and two in an open coastal area, near Pismo Beach. These sites were chosen to be representative of the types of areas encountered along the coast. Two studies were performed in each area so that both the winter and summer seasons could be examined.

The general scenario for the experiments was as follows:

SF6 gas was released within the outer continental shelf area,
outside of 3 nautical miles (nmi) from shore. The plume location
was determined by continuous analyzers in aircraft and ground
vehicles, by grab samples from a boat and on land, and by
stationary one-hour average samplers on land. The release ship
was equipped with a complete set of meteorological
instrumentation, including radiosondes, to determine overwater
conditions. An aircraft performed soundings to obtain mean
meteorological parameter profiles. Onshore instrumentation
included fixed and tetroon borne sensors and a Doppler acoustic
sounder for determining wind profiles.

Several contractors have been involved in these efforts. The Environmental Physics Group of the Naval Postgraduate School (NPS) operated the research ship RV/Acania and was responsible for the overwater meteorological data for all four experiments. The contractors involved in the tracer and onshore experiments are listed in the next section.

Some of the material included here also appears in previous reports. The purpose of this report is to consilidate, in a single document, descriptions of all experiments. This report is divided into three parts: general descriptions, data reduction methods, and data and calculated parameters. No data obtained by other contractors is included here; contractor data reports are available. 2,3 Final documents on the results of the first two experiments are also available. 4,5,6

## II. General Descriptions

## II-1. Participants

The experiments were performed in two phases. Phase I in the Santa Barbara Channel and Phase II in an open coastal location, as described in the introduction. For conformity with previous reports, we refer to the experiments of Phase I as BLM 1 and 2 and Phase II as BLM 3 and 4. The contractors for each of the phases, and their basic responsibilities, are listed in Table 1. The last experiment included more data collection than the first three. NPS contracted with ERCO to supply and operate continuous SF<sub>6</sub> analyzers to obtain additional overwater tracer data and the California Air Resources Board contracted with California Institute of Technology to obtain tracer data over a wide inland geographical area. These additional data will not be available in the reports of the BLM work.

Table 1. Participants in the BLM series of experiments and their responsibilities.

Responsibility	BLM 1 & 2	BLM 3 & 4		
Research Ship	NPS	NPS		
Tracer Gas Measurements	AV	SRI		
Continuous Analyzers	ERCO	BNL		
Onshore Meteorology	MRI	WAK		
Aircraft	Atmospherics	Coastal Air		

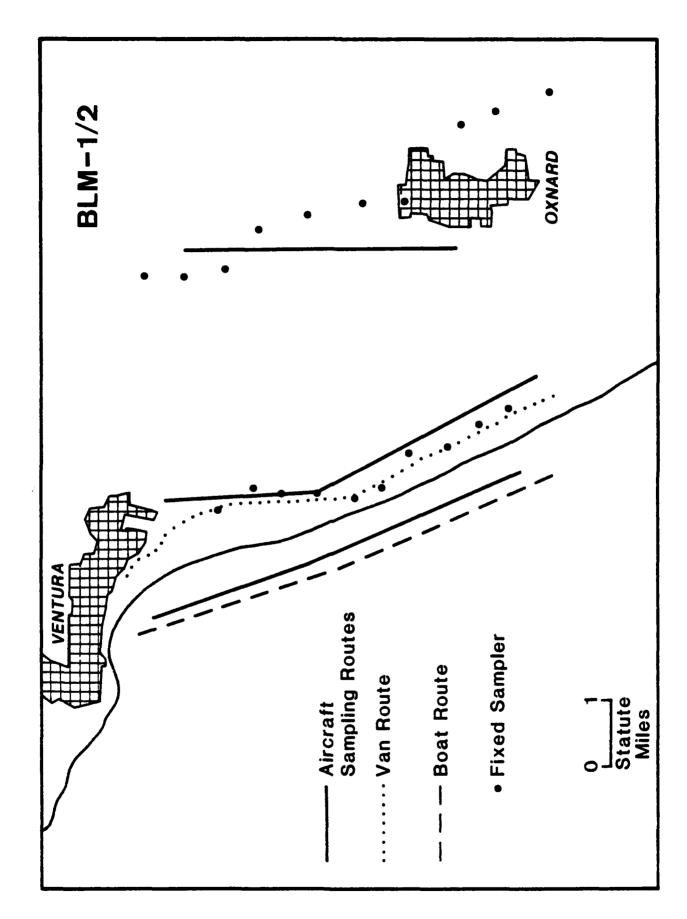
AV-AeroVironment, Inc.; SRI-Stanford Research International; ERCO-Energy Resources Co., Inc.; BNL-Brookhaven National Laboratory; MRI-Meteorology Research, Inc.; NAR-North American Weather Consultants.

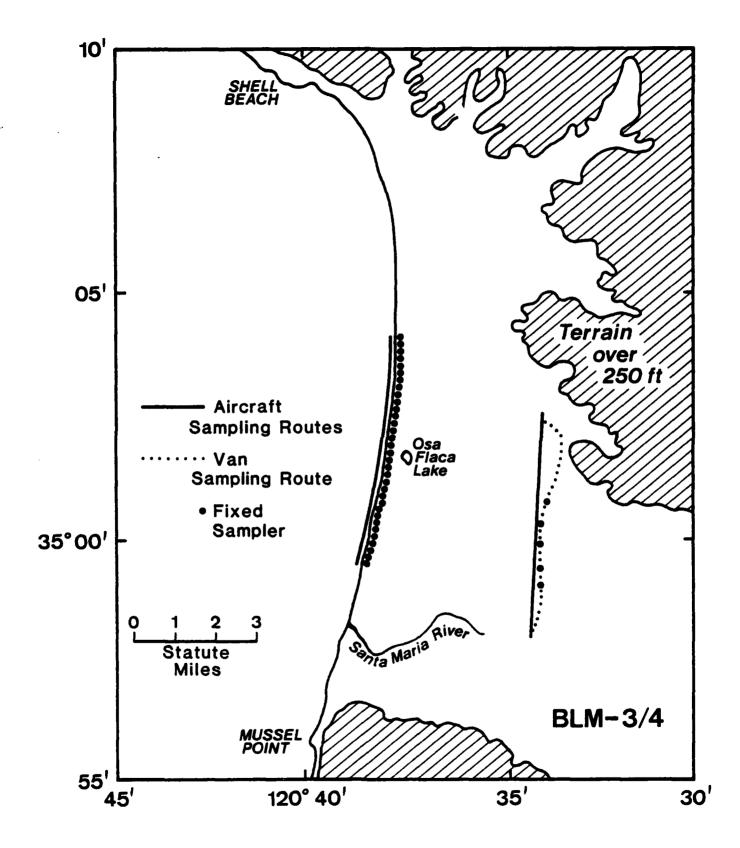
# II-2. Description of Experiments

Charts showing the locations of the ship, aircraft trajectories, and ground level sampling are in Figures 1 and 2. The scenarios for all experiments were similar, although during Phase I near Ventura the ship was approximately 5 nmi from shore, whereas during Phase II off Pismo Beach the distance was 3 nmi. During BLM-1 and 2 the SF<sub>6</sub> tracer gas was released through the exhaust of one of the ship's motor generator sets, which added some heat to the plume. During BLM-3 and 4 the release was at ambient temperature from a tube attached to the ship's radio mast.

The sequence of events on a sampling day was approximately as follows: Throughout the early morning the ship reported winds to the shore command station. These data and shore wind information were used for initial positioning of the ship. Continuous monitoring of the wind was done to determine when the sea breeze had become well established and to position the ship so that at the shoreline the plume would intersect the center of the fixed sampler array. The ship was anchored at a fixed position since movement of the ship during a release would introduce apparent meander to the plume, contaminating the test results. The tracer gas release usually occurred between 1100 and 1300 hours. Mobile sampling began about one-half hour after the start of the release. A complete experiment lasted 6-8 hours. The tracer gas was monitored continuously at the source to produce a constant flow rate.

For all experiments, an aircraft carrying a continuous SF6 analyzer made near shorline transects of the plume at several elevations. The instrument provided readings of the instantaneous concentrations of SF6 in the ambient air as a function of position and time. This allowed the plume dimensions to be defined in both the horizontal and vertical directions. Ground level transects were made by a similarly equipped van, operating at the shoreline and/or inland. Ground level plume concentrations were determined by placing fixed one-hour average collectors along one or more fixed arrays paralled to the shoreline. These samplers were placed close enough together so that several would be within the narrowest plume expected. The array was wide enough so that the plume would be within its extent even if considerable wander occurred. This necessitated the use of a large number of samplers.





# II-3. Description of Localities

The test areas were chosen for two reasons: first, because they are representative of important types of coastal areas, and second, because both are candidates for new or increased outer continental shelf oil development. Thus, the areas afford the opportunity to investigate transport under differing meteorological conditions and also satisfy the needs for BLM modeling for regulatory purposes.

Charts of the geographical areas surrounding the two areas are shown in Figures 3 and 4. The Ventura chart, Figure 3, includes detailed topography because of the importance of the surrounding hills. The Pismo Beach chart only shows the location of prominant hills, which are located far from the experiment area.

In this section the general nature of the localities and the climatological behavior are described in order to outline the expected meteorological conditions. The following section is a description of the synoptic and local conditions during the experiments. The purpose of this description is to delineate the meteorological framework for the tests so that the results can be more easily related to other work and applied to differing conditions off the California coast.

### A. Ventura (Phase I)

Ventura lies within the Los Angeles Bight, an embayment formed by the Santa Barbara Channel, Santa Monica Bay, and the Gulf of Santa Catalina. Pt. Conception, the surrounding hills, and the Channel Islands strongly affect the local flow and produce

local conditions controlled by the interplay of numerous local influences and mesoscale features which are typical of the general coastal area. The air flow in this are is quite different than over the majority of the California coast where an air mass reaches the shore after a long over-water fetch.

The test area was a portion of the Oxnard plain, which is approximately 20 miles long, and extends 5 to 10 miles inland from the beach. The plain is surrounded by hills with peaks two to three thousand feet high. Immediately to the north the coastline runs in a generally east-west direction to Pt. Conception, which is approximately 50 miles away. The geographic features cause many effects, the major ones are as follows:

- 1. The mountains to the north act as a partial barrier to the normal movement of air from the northwest.
- 2. These mountains and the east-west orientation of the shore turn the wind to a westerly direction and produce a complex pattern of eddies.
- 3. Inland hills and the Channel Islands tend to steer the flow, yielding complex trajectories. Winds inside and outside the Channel Islands are different.
- 4. The surrounding high hills contain the cool, moist marine air. Only infrequent, strong, synoptic air mass changes displace the marine air.
- 5. Due to nighttime downslope drainage from the surrounding hills, the diurnal land-sea breeze cycle is very strong, being enhanced by the local topography.

# B. Pismo Beach (Phase II)

Pismo Beach is approximately 50 miles north of Pt.

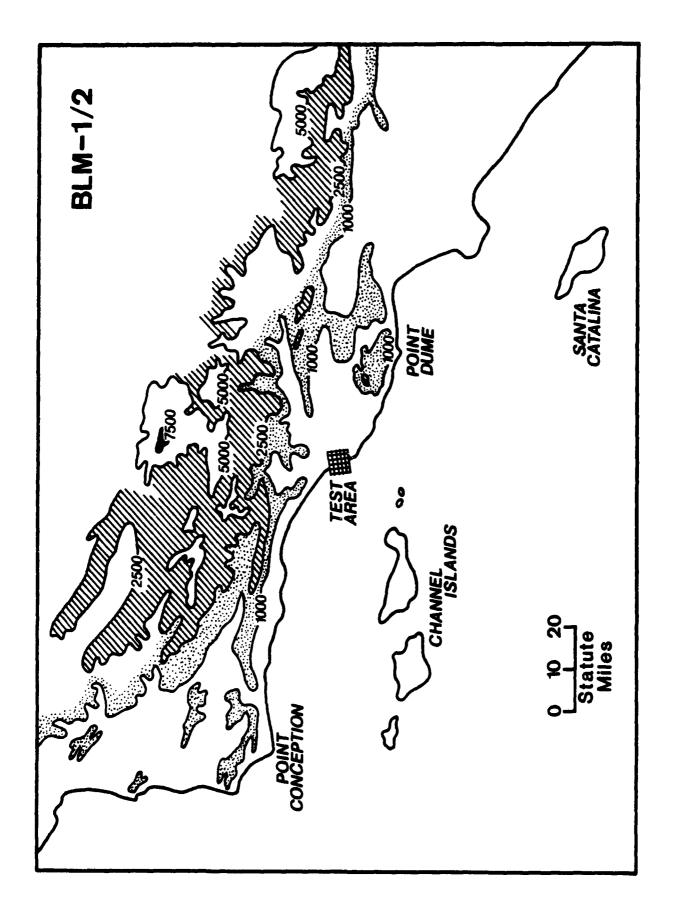
Conception, in a fairly open coastal area. Pt. Buchon, with 1000 to 2000 foot hills, lies immediately to the north, projecting some 5 miles out to sea. The point influences the local flow somewhat but the influence appears to be slight. The immediate inland hills are low giving a weaker land-sea breeze cycle than near Ventura. The experiments were carried out at the mouth of the Santa Maria valley, which steers the local flow slightly. The entrance to the valley at the beach is approximately 8 miles wide and the immediate hills on each side of the valley are only one to two hundred feet high, so their effect is small. The area is representative of an open California region where air mass movement is controlled by the synoptic pressure gradient, giving predominantly northwest flow with a long over-water fetch, and by the land-sea breeze cycle.

## C. California Coast Seasonal Climatology

The synoptic climatology is the same for the two test areas and will be presented here. Also included are historical wind data for the two areas, which include local influences and are site specific.

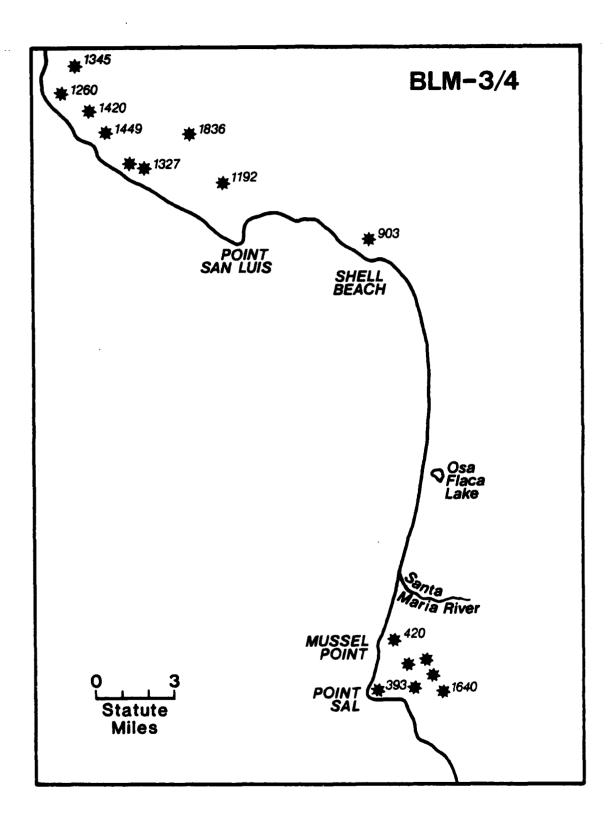
#### Summer

The North Pacific semipermanent subtropical high lies to the west of the area and controls the synoptic scale flow. Clockwise flow around the high produces northwesterlies along much of the coast, with the local sea-breeze turning the wind more westerly.



:

The second of th



The general onshore flow is aided by the inland thermal trough which is created by overland heating. Strong subsidence creates the prevalent capping inversion and the occasional passage of weak upper level troughs will dissipate or lift the inversion for periods of 12-24 hours.

## Fall

The building of high pressure in the Great Basin causes frequent Santa Ana conditions. The pattern of storms and upper level westerlies moves further south breaking up the summer pattern. Frontal passage becomes more frequent and the subtropical high becomes displaced or shrinks, resulting in a break up of the marine inversion.

## Winter

Frontal passage becomes much more frequent and strong surface westerlies often follow the passage. Santa Ana winds can still occur when the surface pressure in the Great Basin becomes sufficiently high. Also, the Pacific High and capping inversion can reform between frontal passage occurrences.

## Spring

As the storm pattern moves north, the Pacific High again becomes the dominant feature. Cold lows pass frequently, followed by strong westerlies.

# D. Wind Climatology

Wind climatologies are useful in determining expected conditions and for assessing whether observed conditions are typical. It is not possible to use the climatology to accurately predict local conditions on a day by day basis but seasonal

patterns are quite reproduceable. In coastal areas, conditions differ from location to location so that site specific climatologies are needed.

Climatological data are presented for Pt. Mugu, CA<sup>7</sup> and Vandenberg Air Force Base, CA<sup>8</sup>, which are near Ventura and Pismo Beach, respectively. Pt. Mugu and Ventura are close geographically, while Vandenberg is approximately 20 miles from the Pismo Beach experiment area. No closer coastal climatology is available. Both data sets were obtained at meteorological stations which are two to three miles inland. The data from Pt. Mugu is much more extensive due to the support needed for the Pacific Missile Range, as is reflected in the data included here.

Monthly wind averages for Pt. Mugu, including the number of days of occurrence of Santa Ana conditions are presented in Table 2. Santa Ana conditions are widespread so that this data would be approximately correct for Vandenberg also.

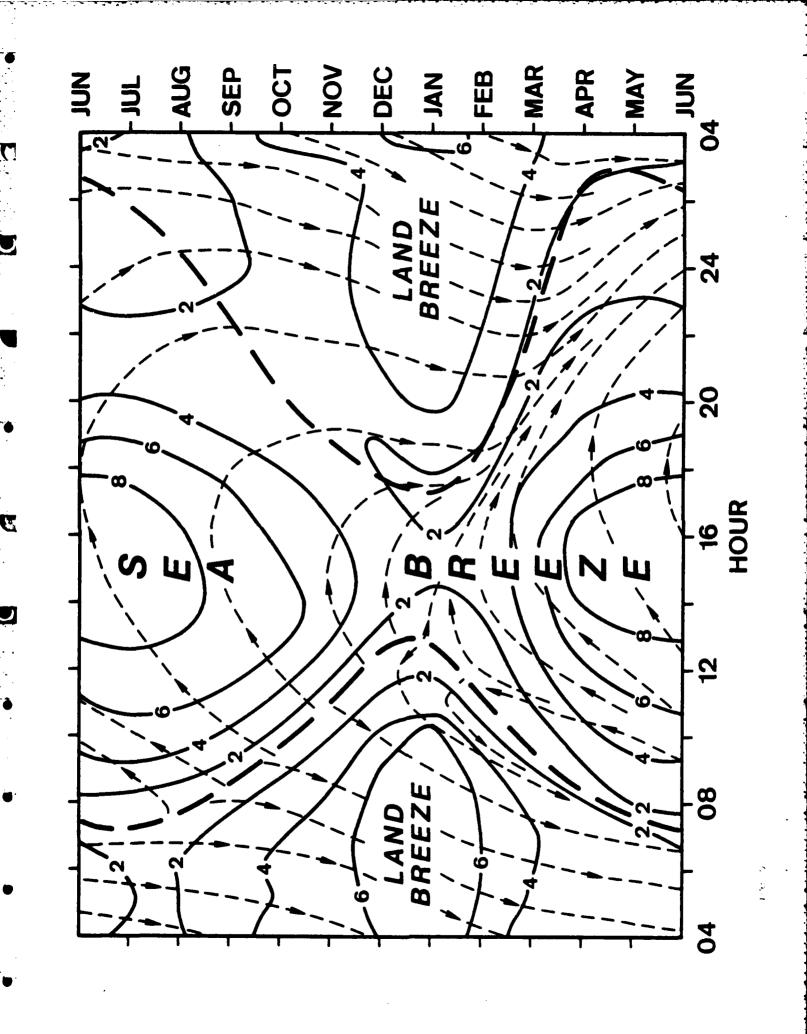
Table 2. Monthly averages of the most frequently observed wind direction, percent of time the wind speed is greater than 21 knots, and the number of days of Santa Ana winds per month. The maximum number is the maximum observed over a ten year period.

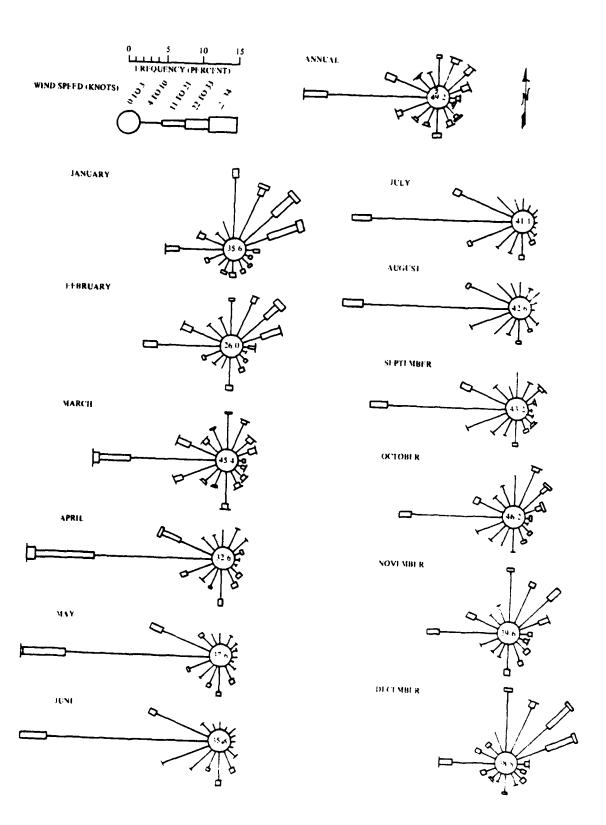
	Most	Santa Ana	Occurance			
Wind			% greater	Average	Maximum	
Month	Direction	Speed	8_	than 21 knots	No. days	No. days
JAN	NE	10	15.5	2.3	9.3	16
FEB	W	9	12.3	1.8	5.2	12
MAR	W	10	18.3	1.1	2.8	8
APR	W	10	26.7	1.4	0.6	2
MAY	W	9	28.7	0.3	0.3	2
JUN	W	ខ	27.5	u.0	0	1 .
JUL	W	7	25.2	0.0	0	0
AUG	W	3	23.6	0.0	0	Ú
SEP	W	7	19.5	0.1	0.4	4
OCT	W	7	16.3	<b>0.5</b>	2.7	ક
VOV	NE	7	12.1	1.0	7.0	19
DEC	N	5	12.8	1.4	9.3	13

Average prevailing winds for Pt. Mugu as a function of time of day and time of year are shown in Figure 5. The dashed lines show wind direction, where a vector from top to bottom on the page indicates a north wind. The solid lines are wind speed isopleths, while the heavy dashed lines approximately divide the land and sea breeze regimes.

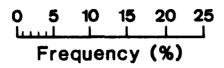
をはない。 「このかのででは、 「 下にはないない 、 下

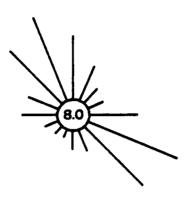
Surface wind roses for each month for Pt Mugu are shown in Figure 6 and for three month periods for Vandenberg in Figure 7. Wind speed is indicated by the width of each "vector", wind direction by the angle, and frequency of occurrence by the length. The numbers in each wind rose circle are the percent of the time the wind is <3 knots. The wind speed averages for Vandenberg are always less than 10 knots, which is not the case for Pt. Mugu. The wind roses for Pt. Mugu contain more information since each monthly average direction shows not just the cumulative average for the month (toPal length of the vector) but also the fractional occurrence for each wind speed category (fractional lengths of the segments of each vector).



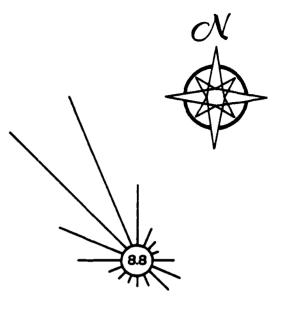


74,023 6

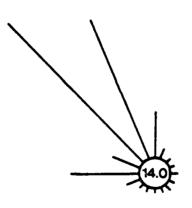




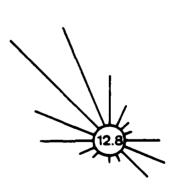
Dec - Feb



Mar - May



Jun - Aug



Sep - Nov

## II-4. Test Periods Weather Description

The following is a description of the synoptic and local conditions during the four test periods. The synoptic conditions are derived from the daily weather maps, weekly series, published by the National Oceanic and Atmospheric Administration. The description of local conditions is based on the overwater meteorological data obtained on the RV/Acania. The data are presented in later sections.

# A. Synoptic Descriptions

BLM-1 (September 1980)

C

General Comments: The whole period was dominated by the Pacific high. All frontal activity was to the north of California. The thermal low over Mexico was not strong enough to produce a dominant onshore flow. The surface pressure gradients in the coastal region were weak, so that the local flow was dominated by the diurnal land-sea breeze cycle. Low subsidence inversions were present under the dominant high pressure. Weak Santa Ana conditions can occur under these conditions.

- 9/22: Surface highs were centered over the Northwest and Wyoming, and pressure gradients in the western U.S. were weak. Strong onshore flow was not expected.
- 9/23: Surface highs were located over Colorado. Pressure gradients were even weaker.
- 9/24: Surface highs were moving in off the Canadian coast. A weak upper level ridge was forming in the same area and a weak trough forming over north central U.S. Surface gradients were increasing off the California coast, causing weak onshore flow.

9/25: Surface highs were located over the northern portion of the continent. The upper level ridge was strengthening, but only over the area north of California, and the trough over the central U.S. was strengthening. Only very weak surface gradients existed in the coastal region.

9/26: A surface low was on the Washington coast and a very large high was situated over the Midwest. The upper level ridge over western Canada was strong but did not extend south to California; the trough was moving to the East coast. The gradients were somewhat higher, with weak onshore flow expected.

9/27: The situation was much the same as on 9/26 with additional highs over the northern U.S. and a weak front moving in off Washington.

9/28: The pattern continued with the addition of a weak frontal passage north of San Francisco and some trailing precipitation.

9/29: A large surface high was centered over Idaho and Nevada. The upper level north-south ridge moved east to extend from Canada into Montana. Location of the high caused weak Santa Ana conditions.

9/30: The thermal low over nothwestern Mexico weakened, essentially disappearing. The whole of the western U.S. was dominated by surface high pressure.

## BLM-2 (January 1981)

The weather patterns for BLM-2 and BLM-1 were similar and general comments will suffice to describe the situation. The

Pacific high was unusually strong producing a mini-drought for what is normally the beginning of the rainy season for California. Frontal passages were again far to the north. There was no well established onshore flow regime except for a short period during 1/12-1/13 when the surface gradient in the Southern California area increased. As before, the land-sea breeze cycle would dominate, however, fairly persistent highs over the inland western U.S. strengthened the offshore flow so that periods of sea breeze were shortened.

BLM-3 (December 1981)

General Comments: Synoptic scale features and associated West Coast flow patterns were typical for this time of the year. An upper air North-South ridgeline over the western states was the dominant feature and led to generally weak surface pressure gradients off the southern California coast. The Mexican thermal low and afternoon sea breeze determined the flow associated with the ridge's presence. Also typical for the time of year was the passage of a fast moving upper wave, and associated precipitation and moderate northwest winds. Another wave was approaching at the end of the period. More detailed descriptions of the synoptic scale features and resulting coastal flow pattern follows.

on 7 December a 500 mb ridgeline extended North-South from eastern British Columbia to southern California. It had a slow eastward progression in advance of an approaching upper level trough extending southward from a closed low centered over the Gulf of Alaska. Coastal winds on 8 December were easterly during most of the day due to the unusual location of the Mexican thermal

trough. Light westerly winds occurred from 1000 to 1600 in conjunction with the local sea-breeze.

The approaching upper level trough crossed the west coast on 10 December and a surface front passed the experimental area late on the same day. An extensive precipitation area existed along the west coast from Southern California to Washington state.

Coastal winds progressed from southerly on 9 December to northerly on 10 December with the frontal passage. The northerly gradient flow behind the front combined with the afternoon sea breeze led to a maximum onshore wind of 15 kts during the afternoon of 11 December.

A weak north-south ridgeline re-established over the West Coast on 11 December and existed through 14 December. A fast moving upper level short wave (trough) moved through the weak ridge and crossed the West Coast in the vicinity of northern Washington on 15 December. The associated surface front reached northern California but did not affect the experimental area. During the 12 to 16 December period the coastal wind directions and speeds exhibited flow associated with a Mexican thermal trough and the afternoon sea breeze. The winds were east to northeast except for the afternoon (1100-2400) when onshore flow (northwest) occurred with speeds of 10-15 kts.

The upper level ridge intensified on 16 December and the associated large surface high region extended from eastern British Columbia to Nevada. The increased gradient on the western side of the surface high led to general easterly winds on 17 December with no discernable influence from the sea-breeze effects.

## BLM-4 (June 1982)

The synpotic scale conditions and resulting precipitation and coastal wind regimes were atypical for the early summer season. The Mexican thermal trough should dominate this region, with resulting light coastal winds influenced by the sea-breeze during this period. Two upper level troughs passed over the west coast during the period. The first (22 June) was a fast moving short wave and the second (28-30 June) was a deep system associated with a closed low at 500 mb, which became nearly stationary over central California. Both systems had considerable north-south extent which led to the southern California surface pressure patterns reflecting their passage. This resulted in a greater than normal offshore pressure gradient and a fairly steady onshore wind, lacking the usual strong land-sea breeze cycle. Hence, strong onshore winds occurred.

During the 21-23 June period, an upper level trough was moving from off the west coast into the mountain states. A surface trough extended from western British Columbia into northern California which was an intensification of the northern extension of the Mexican thermal trough.

During the 24-26 June period, a more intense upper level trough was developing off the west coast. A surface trough line extended from upper Mexico to Washington and the offshore pressure gradient was moderate. By 25 June, a closed 500 mb low had formed west of the Oregon-Washington coastline. The trough and low intensified as they progressed slowly eastward. Precipitation was observed along the northern California coast on both 25 and 26

June and a cold front existed over northern California on 26 June.

During the 27 June - 1 July period, the upper level trough and closed low moved across the west coast. The closed low moved south-eastward and was centered over central California on 30 June. Widespread precipitation occurred over the central and northern California coastal regions on 27 and 28 June and extended southward into the experimental area during the 29-30 June period. A closed surface low and associated frontal systems formed over northern Utah on 28 June. Because of the offshore pressure gradient, winds remained southwest to northwest during this period. They were maximum on 27 June (15-20 kts) and decreased gradually, to a 5-10 kts range, on the remaining days as the above systems moved across the coast and inland.

## II-5. RV/Acania Equipment

The Acania not only served as the platform for the offshore release of the SF<sub>6</sub> tracer gas, but also provided continuous measurement of several critical meteorological parameters. These measurements were performend to document atmospheric transport and stability conditions of the overwater boundary layer during each test day. The basic meteorological and data acquisition equipment has been the same for all four of the experiments. However, as with most experimental programs new equipment has been added for special purposes as the work progressed. The following sections describe all of the equipment that has been used, and indicate with special notations those components which were not used throughout.

# A. Sensors and Their Locations

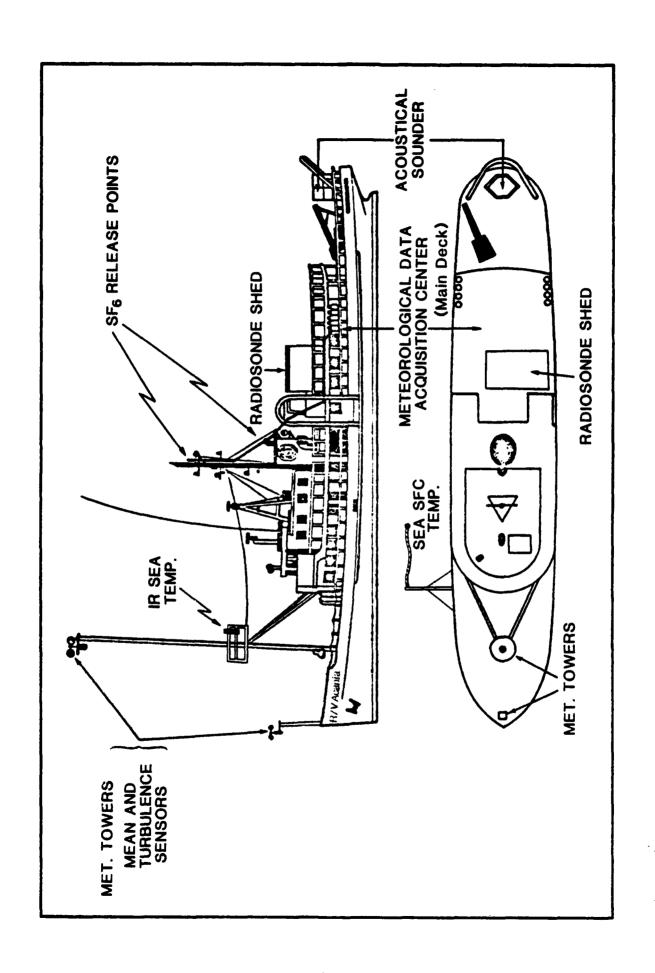
A complete set of meteorological equipment is used on the ship when it is outfitted for atmospheric research. The purpose is to obtain as complete a characterization of the atmospheric boundary layer (BL) as possible. Data of this type is needed for BL modeling in which the Environmental Physics Group is engaged, including transport and dispersion modeling. Basically, what is needed is a determination of the dynamic and mean parameters from the surface to the top of the BL, which is often defined by a temperature inversion. For the purposes of the work described here, the dynamics of the layer are especially important because they are the driving mechanism behind dispersion, and mean properties are needed in order to parameterize models in terms of readily measured quantities.

A side view of the RV/Acania with the locations of the meteorological sensors is shown in Figure 8. The ship has two masts, located on the bow, dedicated to the sensors. The foreward mast is on the tip of the bow and the sensors located there are at a height of 7m above the mean water level; the second mast is 5m behind the bow with sensors at 20.5m above the mean water level. This mast telescopes down to a personnel platform so that the sensors can be made easily accessible. The platform also holds sensors that do not need to be elevated (aerosol and IR sensors).

The ship is approximately 40m long, 7m wide, and only 7m high (9m at the ship's stack). The low profile and narrowness of the ship cause minimal disturbance to the air flow, making it ideal for overwater atmospheric research. The sensors on the high mast are well above any significant ship influence but there is some distortion of the flow at the elevation of the foreward mast. For this reason only data from the upper station are used in subsequent data analysis. Lower mast sensors are used as a backup in the event of an upper sensor failure.

A summary of the monitoring equipment and associate meteorological parameters measure is given in Table 2. Details of the various pieces of equipment can be found in a previous report. The Mini-Ranger and the Ultrasonic Anemometer are new to the BLM-4 experiment and are described below.

The Mini-Ranger is a microwave transceiver-transponder system that is used for accurate positioning of the ship. The transceiver is on the ship and two transponders are on the shore (approximately 3 km apart for BLM-4). The transceiver sends a



coded pulse, the transponder that recognizes the code sends a return pulse, and upon receiving the return pulse the transceiver signal processing determines the elapsed time and, hence, the distance to that transponder. Using two transponders and triangulation, the ship's position can be located to within 2m. In order to obtain this accuracy it is necessary to accurately measure the baseline between the two transponders. This measurement was made with a radar ranger to an accuracy of  $\pm$  10 cm It must be noted here that this system located the ship with respect to the transponders, not the exact geographic location. No attempt was made to reference the transponders locations to a known benchmark.

The sonic anemometer measures the time of flight of a pulse of sound along three directions, two in the horizontal and one vertical. Because the sound propagates through the local air mass, the times of flight can be resolved to determine the wind vector. The system has a transmitter/receiver spacing of 20 cm, a speed resolution of 2 cm/sec, and samples at 440 times/sec. Thus, the system is sensitive to both the wind speed and wind fluctuations well into the inertial subrange. Orientation of the unit is critical, so corrections must be made for both ship orientation and rate of change of orientation. We assume that purely vertical and transverse ship motions and rate of change of yaw are negligible. Then it is possible to correct for ship motion by knowing its speed, roll, pitch, and roll and pitch rates. The angular orientations are sensed by pendulums located on the ship's roll and pitch axes.

Table 3. Meteorological measurements made aboard the RV/Acania and the equipment used.

Measurement	Equipment
Relative Wind Speed	MRI 1022 Wind System
Relative Wind Direction	II .
Air Temperature (T)	100 Ohm Rosemount platinum resistor in a Gill aspirator
Dew Point Temperature $(T_D)$	General Eastern 1200 AP cooled mirror dew pointer, modified for 4 wire resistance
Sea Surface Temperature $(T_S)$	100 Ohm Rosemount platinum resistor and thermal balast in a floating tube and Barnes PRT-5 infrared radiometer (a)
Wind Speed Fluctuation (U')	TSI Constant Temperature Resistance Bridge and 60µ platinum coated quartz resistance probes
Three Axis Wind Velocity and Fluctuation (b)	Kaijo-Denki Ultrasonic Anemometer
Ship Roll and Roll Rate Ship Pitch and Pitch Rate (b)	Pendulums on the ship's pitch and roll axes
Inversion Height ( $z_i$ )	Aerovironment 300 acoustic sounder
Temperature Profile Humidity Profile	Radiosonde
Ship Location	Loran C and Motorola Mini-Ranger III (b)
Aerosol Content (a)	Particle Measurement Systems Optical Counters
Cloud Cover and Weather Conditions	Weather observations

**a**)

a) Not used on BLM-4 b) Used only on BLM-4

## 3. Data Acquisition and Recording

Four methods of data acquisition and recording are used: strip charts, analog tape recorders, computer controlled data acquisition and recording systems, and spectral analysis. (Direct digital tape recording of aerosol data is also used but those data are not important for this work.)

Strip chart recording is used only for the acoustic sounder, relative wind direction and speed, and the wind fluctuation signals from the hot films (TSI system). The internal strip chart is the only output available from the acoustic sounder. The other strip chart data are seldom used for analysis. These recordings are made because they provide an immediate check on shipboard conditions.

The analog tape recorder is essentially a back up instrument. Every signal that can be is recorded in this manner. The temperatures are measured by resistors, which cannot be readily analog recorded. If failure of the primary data acquisition equipment should occur, it is possible to retrieve the data by using this recording.

The central data acquisition components are the computer controlled data acquisition systems. Two are used: one dedicated to the ultrasonic anemometer and the ship motion sensors, the second devoted to obtaining meteorological data. A computer operates a scanner, voltmeter, and printer, and files data and calculated parameters on its internal cassette tape.

The basic procedure for acquiring data for a given time period and averaging using a computer and scanner is straightforward and will not be described here. We store only averaged

data and calculated parameters to prevent using a large amount of computer memory and/or tape storage. All of the data and parameters are also printed at the end of an averaging period, providing a hard copy output and real time assessment of systems behavior.

The actual averaging used is somewhat complex since we need to obtain both short term averages for turbulence parameters and long term averages for mean parameters. We use 10 sec and one-half hour intervals for the averaging periods. A data acquisition cycle takes approximately 1 sec so that 10 readings are obtained for each short term average. All 10 sec averages are held in computer memory until the end of the one-half hour period, when they and the mean data are averaged for the period. Then both short and long-term averages are stored on tape and all long-term averages are printed.

True wind direction, corrected for ship's roll, and the true wind speed are obtained as short term averages from the meteorological data acquisition system. The ultrasonic anemometer outputs are processed to obtain short term averages of the three wind vectors, corrected for ship's pitch and roll.

Spectral analysis has two functions: to determine the power spectral density of turbulence signals and to detect and identify system noise which would invalidate results obtained by other acquisition methods. It is normally used on a regular basis only for the hot-film signals.

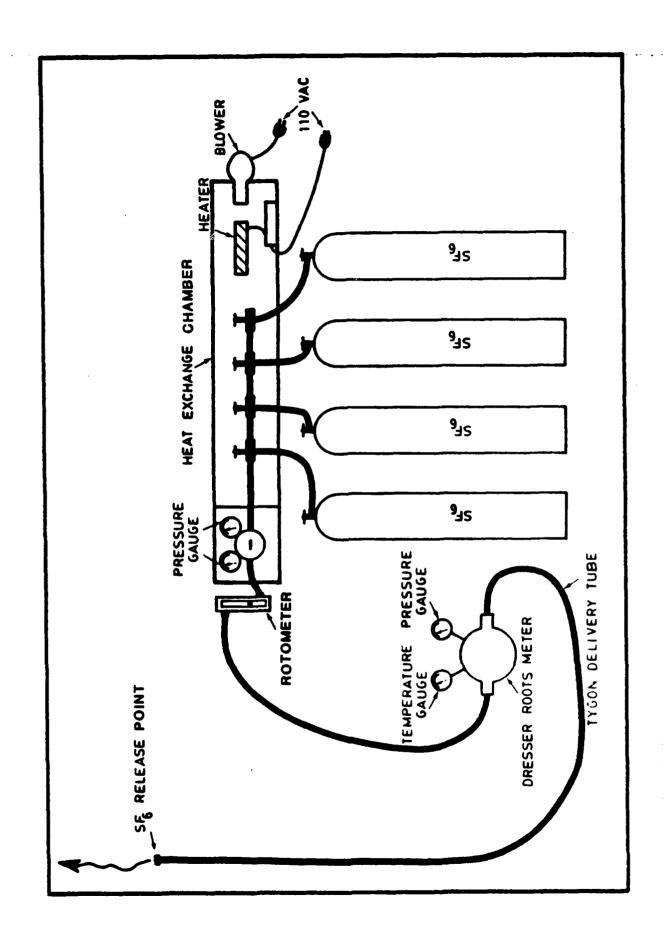
## II-6. SF<sub>6</sub> Gas Release, Equipment and Rates

The SF<sub>6</sub> used in these experiments was contained, in liquid form, in pressurized cylinders. When it is released, expansion produces considerable cooling, which can make maintaining a constant flow difficult. For this reason, the gas is passed through a heated manifold, shown in Figure 6, to bring it to ambient temperature before the flow measurement and gas release. Heating the manifold is accomplished by blowing air over a Variac controlled heating element, and flowing that air over the manifold in a wooden enclosure. As many as four bottles can be connected to the manifold. The number of bottles used depends on the flow rate. Using more bottles decreases the expansion rate and the cooling.

The output from the manifold goes to a pressure regulator, a rotometer for coarse monitoring of the flow, and the flow measuring device. For BLM-1 and 2 the flow was measured by a calibrated rotometer supplied by AeroVironment, Inc.; for BLM-3 and 4, SRI used a Dresser Roots Meter.

During BLM-1 and 2 the gas was released through a ship's exhaust stack at 26'7" above the water. During BLM-3 and 4 the release was at 43' and 44'8" above the water respectively, with the gas at ambient temperature. The pertinent parameters to calculate plume rise for the cases of the gas relused with the heated exhaust are given in Table 3.

The flow rates in Table 3 are determined from the weights of the gas bottles before and after a release and the elapsed time. The bottles were weighed by NPS before and after the start of a cruise (except for BLM-1, where weighing was also done in the



middle of the cruise). Checks on bottle weights over a long period has shown that leakage while not in use is insignificant. Note that flow rates are not available for BLM-4. This was due to operator failure when performing the initial weighing for that cruise.

The flow rate determined from bottle weight is a useful quantity, and should perhaps be the absolute calibration for determining the total amount of gas released. The nominal release rate for BLM-1 and 2 and the first experiment of BLM-3; was 50 lbs/hr; all subsequent experiments used 25 lbs/hr. For BLM-1 and 2 the weight determined flow was somewhat less than the flowmeter value, which was reasonable considering the low accuracy of the rotometer used. For BLM-3 the weight determined value was about 20% high. This was surprising since an accurate Roots meter was used for continuous flow monitoring. One possible explanation for the discrepancy is undetected gas leaks between the bottles and the flow meter.

Table 4. Flow characteristics of the SF $_6$  gas releases for the t four BLM experiments.

		Exhaust Flow & Temp	SF <sub>6</sub> Flow Rate		Plume Hea Output
Release		(Cu ft/hr)	(Cu ft/hr)	(lbs/hr)	(Watts)
DIM 1	ш 1	10.1-103 (008a)	126	40.01	4446
BLM-1	#1	19.1x10 <sup>3</sup> (99°C)	126	49.01	4440
	#2	14.9x10 <sup>3</sup> (121°C)	131	50.74	4370
	#3	••	125	48.54	11
	#4	"	124	47.91	II
BLM-2	#1	**	125	48.35	11
	#2	"	124	48.06	H
	#3	11	115	44.45	11
	#4	10	119	46.21	11
BLM-3	#1	None	153	59.40	None
	#2	10	77.6	30.09	11
	#3	11	77.1	29.88	11
	#4	п	74.9	29.05	II
	#5	rı .	75.5	29.25	II
BLM-4	#1	11	Not Available		11
	#2	#	11		11
	#3	I <del>I</del>	11		11
	#4	н	41		**
	#5	· ·	11		11

### III Data Reduction Methods

Data reduction is directed toward producing mean meteorological parameters and parameters which describe the turbulence in the marine layer. The mean quantities are easy to calculate from sensor response functions and the techniques need not be described here. Characterizing the turbulence requires sophisticated techniques and is subject to error caused by measurement uncertainties and by misinterpretation of the measurements. In this section the several methods used to make these determinations are described. The redundancy in methods provides cross checks on the results.

The quantities of interest are the horizontal wind direction variance  $\sigma_{\theta}$ , the vertical wind direction variance  $\sigma_{\phi}$ , the wind speed variances  $\sigma_{u}$ ,  $\sigma_{v}$ , and  $\sigma_{w}$ , the rate of dissipation of turbulence kinetic energy, the friction velocity, and the convective mixing velocity. All of these quantities describe various aspects of turbulence mixing in the atmosphere and are important for describing expected plume properties. Also, some measure of the hydrostatic stability must be made to characterize the state of the surface layer. For this we use the Monin-Obukhov length.

Determination of the wind variances is straightforward. Ten second averages of all components, corrected for pitch, roll, and ship velocity are available from the data acquisition system stored data. These quantities can be used as is or formed into longer term averages and thus related to short and long term plume properties. The only redundency here is that direction variances

can be determined both from the ultrasonic anemometer and from the cup and vane wind data.

The stability, friction velocity, dissipation rate, and mixing velocity are all determined using the bulk-aerodynamic method. The method is valuable because it makes use of readily measured quantities, specifically, differences in mean temperature, wind, and water vapor at the surface and at some reference height. Turbulence measurements from the hot films can also be used to determine these parameters. This is the back up method used to check the validity of the results. The bulk method is described below in detail, followed by a brief description of the signal processing and calculations involved in the turbulence method.

## A. Bulk Aerodynamic Method

In this method it is assumed that the pertinent meteorological parameters (T = temperature, U = wind speed, and q = water vapor mixing ratio) have vertical gradients which are inversely proportional to height, Z. The magnitude of a gradient is parameterized by a scaling quantity,  $X_{*}$  (X = T, U, q) and a stability correction function  $\phi_{X}(\xi)$ :

$$\frac{\mathrm{d}X}{\mathrm{d}Z} = \frac{X \star}{\alpha_X \kappa_Z} \phi_X(\xi). \tag{1}$$

 $\xi$  = Z/L, with L the Monin-Obukhov length, is the stability parameter used.  $\kappa$  is VonKarman's constant, 0.35, and  $\alpha_{\rm X}$  is the turbulence diffusivity ratio ( $\alpha_{\rm U}$  = 1). For convenience we drop the subscript on  $\alpha$ .

Current evidence shows that transport of the scalars, heat and water vapor, obey the same relationship to their gradients. Thus  $\phi_T = \phi_q$  and  $\alpha_T = \alpha_q = 1.35$ . The stability correction functions are:  $^{10}$ 

$$\phi_{\mathbf{T}}(\xi) = (1-9\xi)^{-1/2} \qquad \xi < 0 \qquad \phi_{\mathbf{u}}(\xi) = (1-15\xi)^{-1/4} \\
= 1+6.4\xi \qquad \xi > 0 \qquad = 1+4.7\xi \qquad (2)$$

The Monin-Obukhov length is a measure of the balance between wind driven turbulence and buoyancy. It is defined as

$$L = \frac{T}{\kappa g} \frac{(\overline{wu})^2}{(\overline{w\theta})}$$
 (3)

where g is the acceleration due to gravity. For our purposes it is most convenient to rewrite L in terms of the scaling parameters:

$$L = \frac{T}{\kappa g} \frac{U \star^2}{\theta_U \star} \tag{4}$$

 $\theta_{\mathbf{V}}$  is the virtual potential temperature.

The above are the basic equations used to describe the atmospheric surface layer. The bulk method uses measurements of mean properties to evaluate L and the  $X\star$ . In order to develop the needed relations Equation 2 is integrated from the surface to

the measurement height, Z. The integration is actually carried out from some reference height,  $Z_{\rm OX}$ , very near the surface.  $Z_{\rm OX}$ , the roughness length, is used in recognition of the fact that the logarithmic profile may not extend all the way to the surface. For measurement purposes, a measurement at the surface, rather than at  $Z_{\rm O}$ , is used with no loss of accuracy. The integration gives  $Z_{\rm O}$ 

$$x_{Z} - x_{S} = \frac{X_{\star}}{\alpha \kappa} \int_{O} \frac{\phi_{X}(\xi)}{Z} dZ$$

$$= \frac{X_{\star}}{Z_{OX}} \left[ \ln \frac{Z}{Z_{OX}} - \psi_{X}(\xi) \right], \qquad (5)$$

where  $X_S$  is the surface value and  $\psi_X(\xi)$  is the profile stability function. The profile stability functions are obtained upon performing the integration and are:

$$\xi > 0:$$
  $\psi_{\rm T} = -6.5\xi$   $\psi_{\rm U} = -4.7\xi$ 

$$\xi < 0: \qquad \psi_{T} = 2 \ln(\frac{1+x}{2})$$
with  $x = (1-9\xi)^{1/2}$ 

$$\psi_{U} = 2 \ln(\frac{1+y}{2}) + \ln(\frac{1+y^{2}}{2}) - 2 \tan^{-1}y + \frac{\pi}{2}$$
with  $y = (1 - 15\xi)^{1/4}$ 

The difficulty in carrying out analyses of data is immediately apparent upon examination of Equations 4 and 5. They cannot be solved analytically for  $X_*$  and  $\xi$ , necessitating the use of an iterative calculation with a convergence test. Note that there are two homogeneous equations and three unknowns:  $X_*$ ,  $\xi$ (or L), and  $Z_{OX}$ . In order to use an iterative calculation the number of unknowns must be reduced to two. This is done by determining the roughness length,  $Z_O$ , from the wind speed (for  $X_O$ ) we drop the subscript) and assuming a constant value for  $Z_{OX}$ . This will be described more fully below.

In developing the iteration scheme it is more convenient to rewrite Equation 5 in terms of the drag coefficient. The drag coefficient,  $C_{\rm X}$ , is defined to be the constant of proportionality between the scaling parameter and the air-sea difference.

$$X_* = C_X^{\frac{1}{2}} (X_2 - X_s).$$
 (7)

Thus, from Equation 5, the drag coefficient is

$$C_X^{\frac{1}{2}} = C_{NX}^{\frac{1}{2}} [1 - \psi_X(\xi) C_{XX}/\alpha \kappa]^{-1},$$
 (8)

where the neutral stability drag coefficient is defined as

$$C_{NX}^{\frac{1}{2}} = \frac{\alpha \kappa}{\ln z/z_{0}}.$$
 (9)

The stability parameter,  $\xi = Z/L$ , can be expanded from Equation 4 as

$$\xi = \frac{gZ}{T} \frac{\theta_* + 0.61 \text{ Tq*}}{U_*^2}$$
 (10)

For the humidity correction term, T = 288°C is used and 0.61  $T \simeq 0.18$  (q in gm/kg), introducing negligible error. Rewriting in drag coefficient form gives

$$\xi = \xi_{0} \frac{[1 - \psi_{U} C_{NU}^{\frac{1}{2}}/\kappa]^{2}}{[1 - \psi_{T} C_{NT}^{\frac{1}{2}}/\alpha\kappa]},$$
(11)

with

$$\xi_0 = \frac{\kappa gZ}{T} \frac{C_{NT}}{C_{NU}} \frac{(\theta - \theta_s) + 0.18(q - q_s')}{U^2},$$
 (12)

where U = 0 is assumed at the surface. Note that  $\xi_0$  depends only on the measured meteorological quantities and the neutral stability drag coefficients. Thus, it can be directly determined and used as the first estimate in determining  $\xi_0$  for the iteration scheme.

Either the neutral stability drag coefficient or the roughness length can be specified to reduce the number of unknowns to two (they are related by Equation 9). The former is done here. For temperature the drag coefficient is 11

$$C_{NT} = 1.3 \times 10^{-3},$$
 (13)

whereas for wind the formulation of Kondo<sup>12</sup> is used (for a height Z = 10m):

U(m/sec)	$C_{NII} \times 10^3$		
0.3 - 2.2	1.08 U-1.5		
2.2 - 5.0	0.77 + 0.086 U		
5.0 - 8.0	0.87 + 0.067 U	(14)	
8.0 - 25	1.20 + 0.025 U		

The iteration scheme used to perform the data analysis is as follows:

- 1. Calculate  $q_s$  from  $T_s$  assuming a relative humidity of 100% at the surface. Calculate q from T and the relative humidity or from the dew point temperature,  $T_D$ .
- 2. Calculate  $\xi_0$  from Equation 12 using the meteorological data and the neutral stability drag coefficients.
- 3. Calculate  $\psi_{\mathbf{U}}$  and  $\psi_{\mathbf{T}}$  from Equation 6.
- 4. Calculate  $\xi$  from Equation 11.
- 5. Iterate steps 3 and 4 until the desired accuracy is obtained, giving  $\xi$  (and L).
- 6. Calculate  $U_*$ ,  $\theta_*$ , and  $q_*$  from Equation 7.

# B. Turbulence Method

The fluctuation signal from the constant temperature film is analyzed by determining the power spectral density in the inertial subrange. For this purpose two methods, are used 1) spectral

analysis and 2) determining the rms level of the signal after band pass filtering. The purpose is to obtain  $U_{\star}$  and the rate of dissipation of turbulent kinetic energy, . These two parameters are related by  $^{13}$ 

$$\varepsilon = (U^3/\kappa_Z) \phi_{\varepsilon}(\xi), \qquad (15)$$

where  $\phi_{\epsilon}$  is the dissipation stability function. It is calculated using the bulk determined  $\xi$  in the following equations

$$\phi_{\varepsilon}(\xi < 0) = (1 + 0.5|\xi|^{2/3})^{3/2},$$

$$\phi_{\varepsilon}(\xi > 0) = (1 + 2.5\xi^{2/3})^{3/2}.$$
(16)

The power spectral density is related to the dissipation rate

$$S(k) = 0.5 \varepsilon^{2/3} k^{-5/3}$$
, (17)

where k is the wavenumber of the turbulence. If the fluctuation signal from a single sensor is bandpass filtered at lower and upper wave numbers k and  $k_u$ , then the square of the rms signal is

$$(U'_{rms})^2 = \int_{k_0}^{k_0} s(k) dk.$$
 (18)

Substituting Equation 17, integrating, and introducing frequency using the frozen turbulence hypothesis, k = 2 f/U, gives

$$\varepsilon^{2/3} = \frac{4}{3} \left( \frac{2\pi}{U} \right)^{2/3} \quad (U'_{rms})^{2/(f_{\ell}^{-2/3} - f_{u}^{-2/3})}. \tag{19}$$

Thus, a measurement of the rms signal yields  $\varepsilon$  directly.

The spectral analysis method uses Equation 17. A spectrum analyzer gives the power spectral density as a function of frequency. Thus, Equation 17 is rewritten for frequency using fS(f) = kS(k) and solving for  $\epsilon$ .

$$e^{2/3} = 2\left(\frac{2\pi}{U}\right)^{2/3} f^{5/3} s(f).$$
 (20)

A 5/3 slope is fitted through the spectrum in the inertial subrange ( 5 to 100 Hz) and extrapolated to f = 1 Hz to determine S(1 Hz).

In both Equations 19 and 20 the wind speed fluctuation signal is needed, whereas measurements yield a voltage fluctuation level. The wind speed signal can be obtained from the response function of the constant temperature films used as sensors. The voltage response to wind speed is given by

$$V^2 = V_0^2 + B\sqrt{U}. {(21)}$$

Differentiating this equation gives

$$dU/dV = 4 V \sqrt{U/B}.$$
 (22)

Thus

$$(U'_{rms})^2 = (4V\sqrt{U/B})(V'_{rms})^2$$
 (23)

$$S(1 Hz) = (4V\sqrt{U/B})S_V(1 Hz)$$
 (24)

where  $V'_{rms}$  is the measured rms voltage fluctuation and  $S_V(1 \text{ Hz})$  is the voltage power spectral density at 1 Hz determined by the spectrum analyzer. Equations 23 and 24 are substituted into Equations 19 and 20 to yield the final equations used to determine  $\varepsilon$ . Note that the measurements are always made over a time interval of the order of one-half hour. V and U are the voltage and wind speed averages over that period.

# C. Convective Mixing Velocity

The above data analysis is made on data gathered in the atmosphere's surface layer (perhaps 50 m deep) and applies to that region. The scaling parameters determined can be used to

calculate the surface layer fluxes of momentum, heat, and water vapor:

$$F_{m} = U*^{2},$$

$$F_{h} = -U*\theta_{V}*,$$

$$F_{q} = -U*q*.$$
(25)

These are not the true fluxes, but those normalized by density and specific heat.  $F_{\rm h}$  is the virtual rather than the sensible heat flux.

The surface layer scaling developed above applies only to that layer. If the boundary layer is well mixed covective scaling applies in the region above the surface layer. The appropriate scaling parameters for this region are  $^{14}$ 

$$\omega_{\star} = [(g/T)F_h Z_i]^{1/3}$$

$$H_{\star} = F_h/\omega_{\star}$$
(26)

 $Z_i$  is the boundary layer depth, normally defined by the height of an inversion layer, and  $\omega_*$  is the convective mixing velocity.

 $\omega\star$  is the appropriate velocity to use to determine the rate of mixing in the convective boundary layer. This has been demonstrated by previous SF6 tracer experiments  $^{15}$  and by laboratory experiments.  $^{16}$ 

Equation (26) is not correct for the cloud topped boundary layer. In that case the presence of the cloud modifies the heat flux due to release of latent heat upon condensation and absorption and emmission of radiation. The term  $F_h$  must be replaced with 2.5  $\langle F_h \rangle$ , the average heat flux in the boundary layer. Use of the equation as it stands will typically lead to underestimates of about 30% (it is this small due to the 1/3 power dependence of  $\omega *$  on  $F_h$ ).

# A. Gas Release Locations and Times

The location of the RV/Acania during each  $SF_6$  gas release and the release start and end times are listed in Table 5. The ship locations listed were determined by the ship's Loran C.

Table 5. Locations and start and end times for tracer gas releases. Times are Pacific Local.

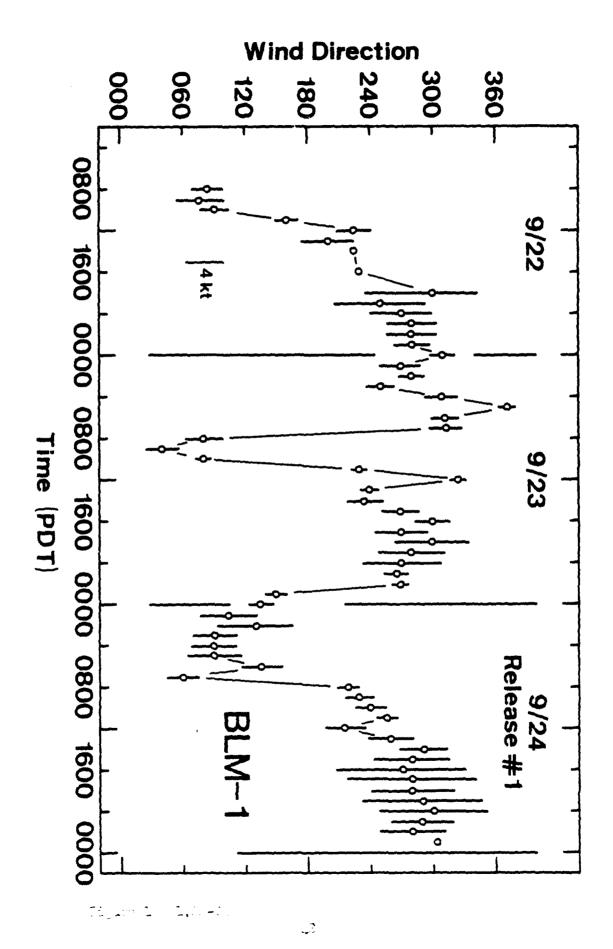
Release	Date	Latitude	Longitude	Start Time	End Time
BLM-1					
1	9/24	34°14.2'N	119°21.2'W	1135	1900
2	9/27	34°14.8'N	119°21.1'W	1107	1815
3	9/28	34°14.2'N	119°21.1'W	1243	1900
3 4	9/29	34°12.8'N	119°20.4'W	1143	1900
BLM-2					
1	1/6	34°15.0'N	119°20.0'W	1322	1800
	1/9	34°14.4'N	119°20.3'W	1123	1800
2 3		34°14.4'N	119°20.3'W	1134	1702
4	1/15	34°11.4'N	119°19.4'W	1406	1700
BLM-3					
1	12/8	35°2.6'N	120°42.1'W	1158	1658
2	12/11	35°4.0'N	120°41.9'W	1229	1849
3	12/13	35°2.9'N	120°42.0'W	1152	1852
4 5	12/14	35°3.3'N	120°41.8'W	1038	1858
5	12/15	35°3.5'N	120°41.8'W	1117	1902
BLM-4					
1	6/21	35°2.9'N	120°42.1'W	1221	1800
2	6/22	35°0.5'N	120°42.3'W	1339	2000
2 3	6/24	35°2.1'N	120°42.0'W	1148	1800
4 5	6/25	35°2.2'N	120°42.1'W	1040	1800
5	6/27	35°3.5'N	120°42.0'W	1030	1300

### IV. Data and Results

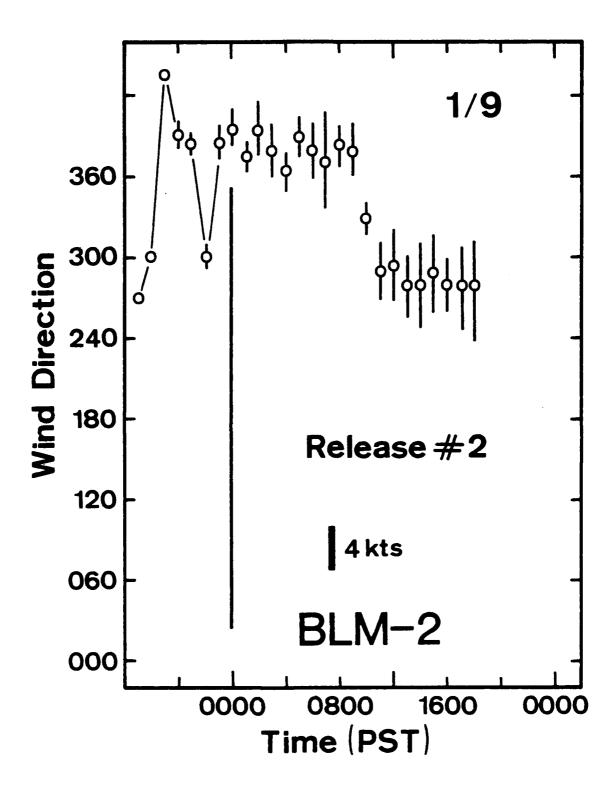
In the following sections the data for the four cruises and the calculated results are presented. The sections are grouped according to the type of data, not the cruise, in order to make it easier to compare data from all cruises.

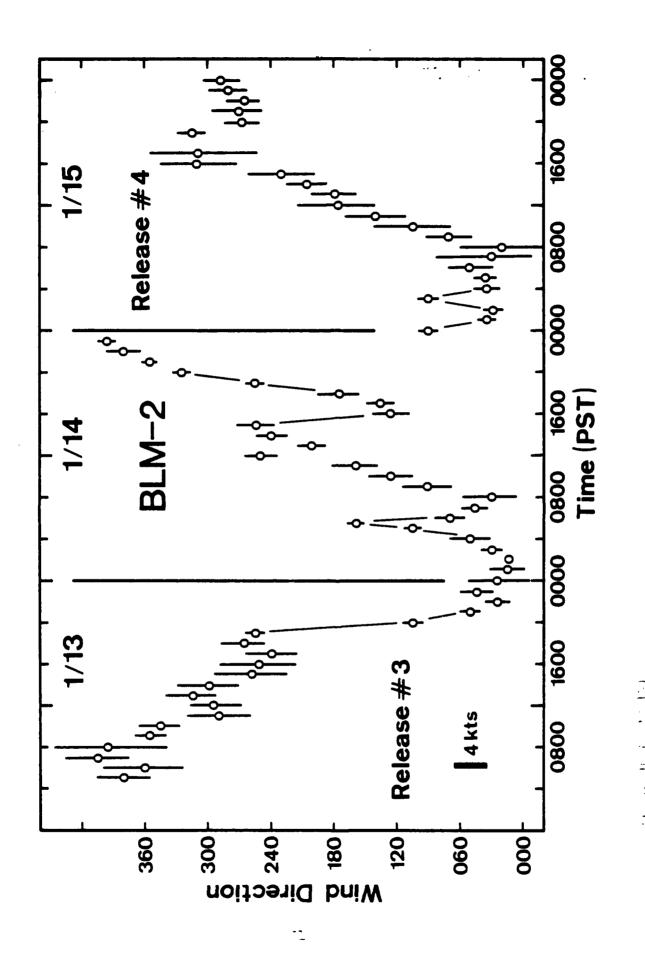
### IV-1. Wind Histories

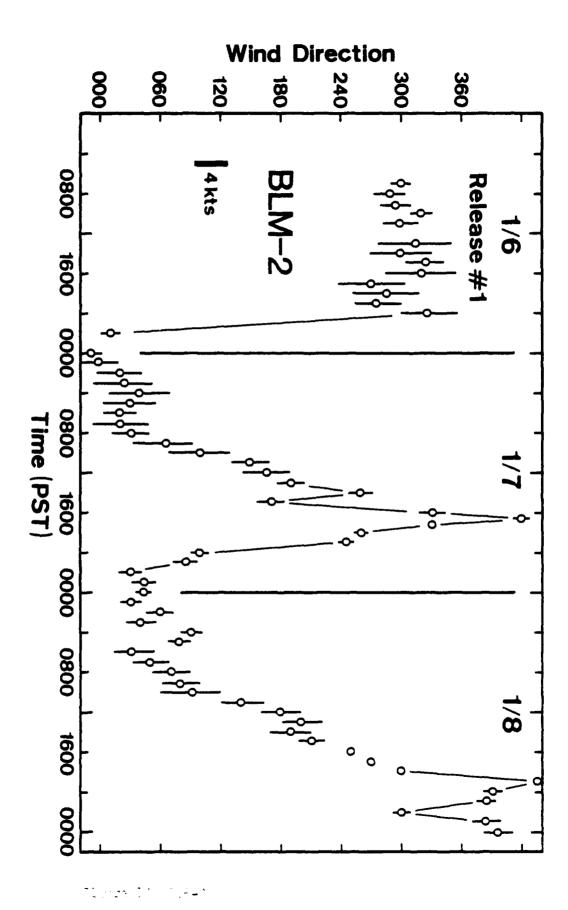
During the time the ship was on station, wind data was obtained at least every one-half hour. These data are plotted and yield a real-time history which is useful for planning the times of tracer gas releases. The data are presented in Figures 10, with three days plotted in sequence so that the diurnal land-sea breeze cycle can be readily identified.



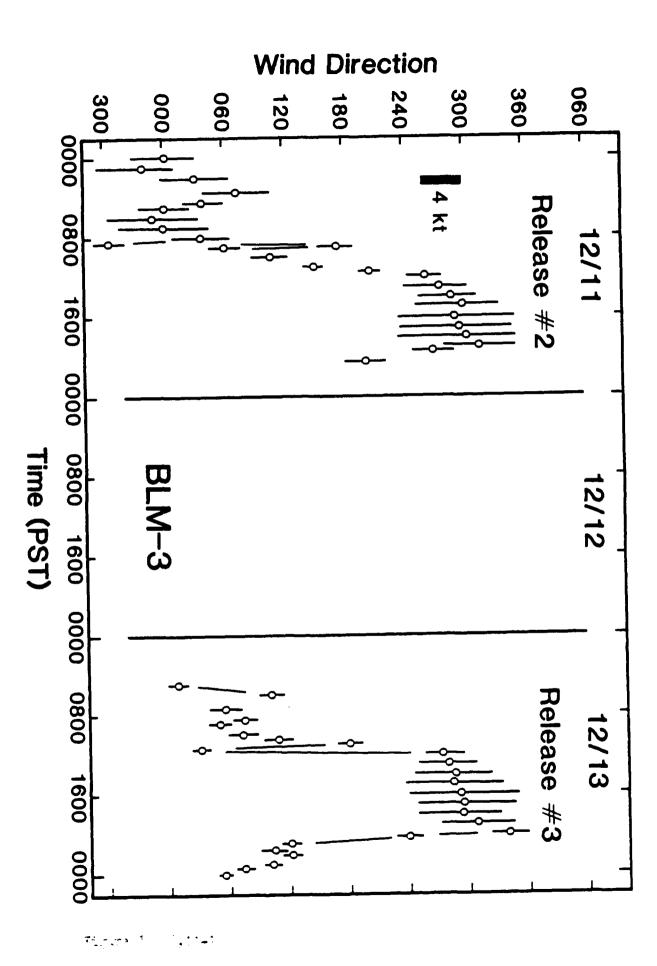
Pirme 10 (1,27-29)







Migure 10 ( ) - 100



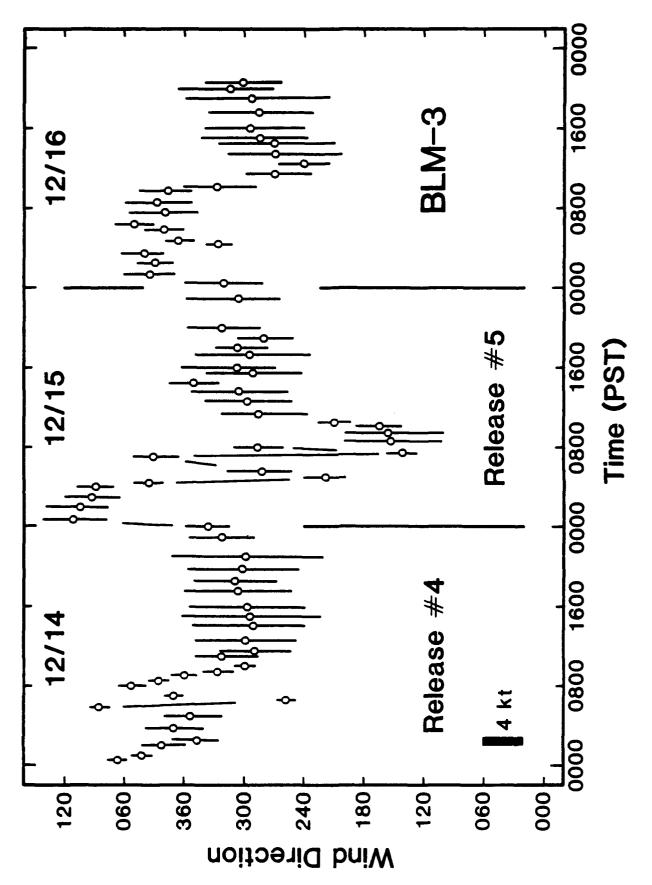
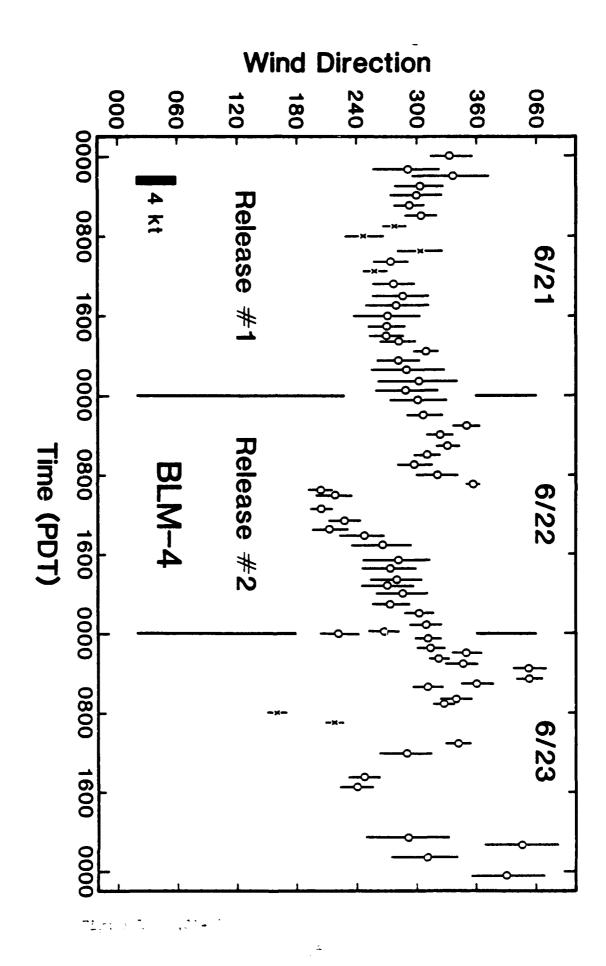
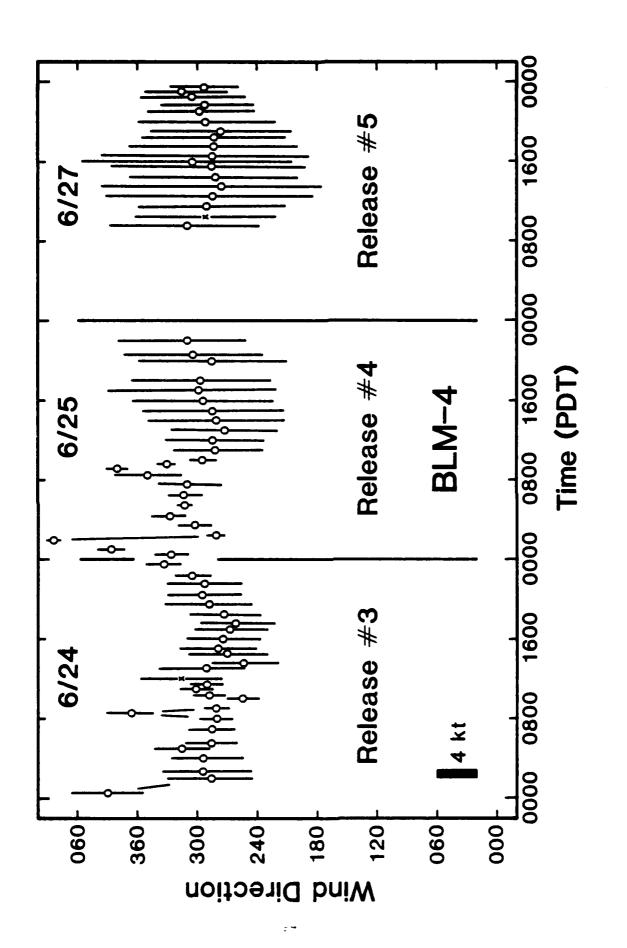
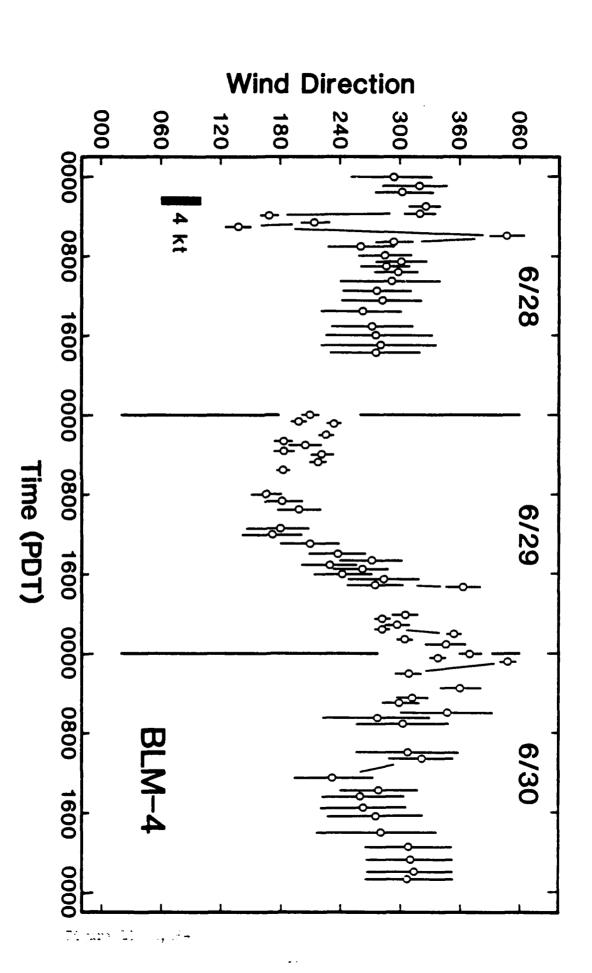


Figure 40 (3,1,-16)







#### IV-2. Acoustic Sounder

The acoustic sounder was operated continuously throughout all cruises to obtain a continuous record of the boundary layer depth, in order to define the height of the mixing region. This instrument is very useful when there is a single, well defined, temperature inversion yielding an unambiguous indication on the sounder strip chart. As can be seen from examination of the results, this is not always the case.

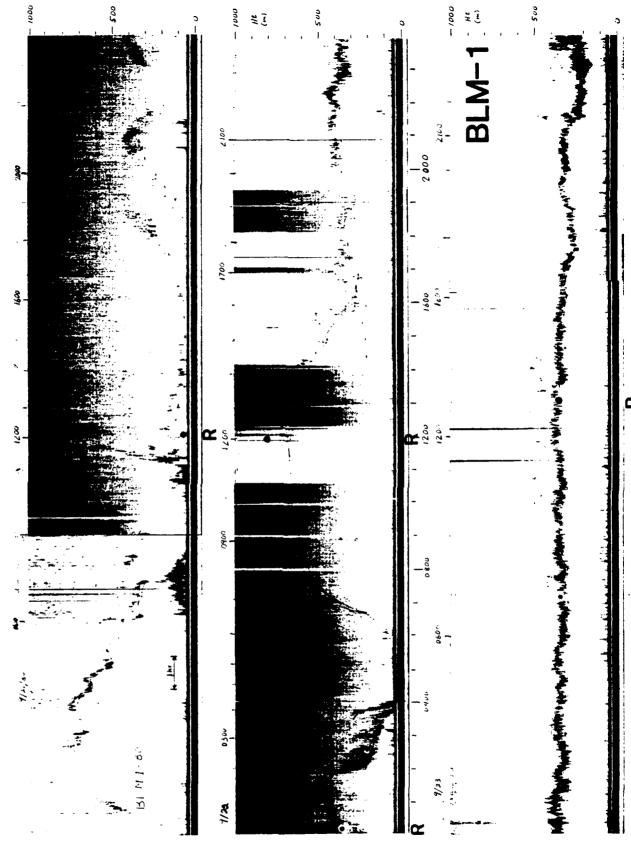
The sounder transmits a pulse of acoustic energy and receives reflected sound that is scattered from small scale speed of sound inhomogenities, which are mainly due to temperature inhomogeneities. These inhomogeneities occur due to the turbulent mixing of air of varying temperature in the region of a temperature inversion, in thermal plumes, and any other region where inhomogeneities exist. Thermal plumes are easily identified since they give a strong near surface return. The strongest acoustic echo that is not associated with thermal plumes is normally from the base of an inversion. However, when the temperature gradient at the inversion is weak this may not be the case. In many cases there may be several echos from different heights so that the mixing layer depth cannot be determined without additional data, such as from a radiosonde.

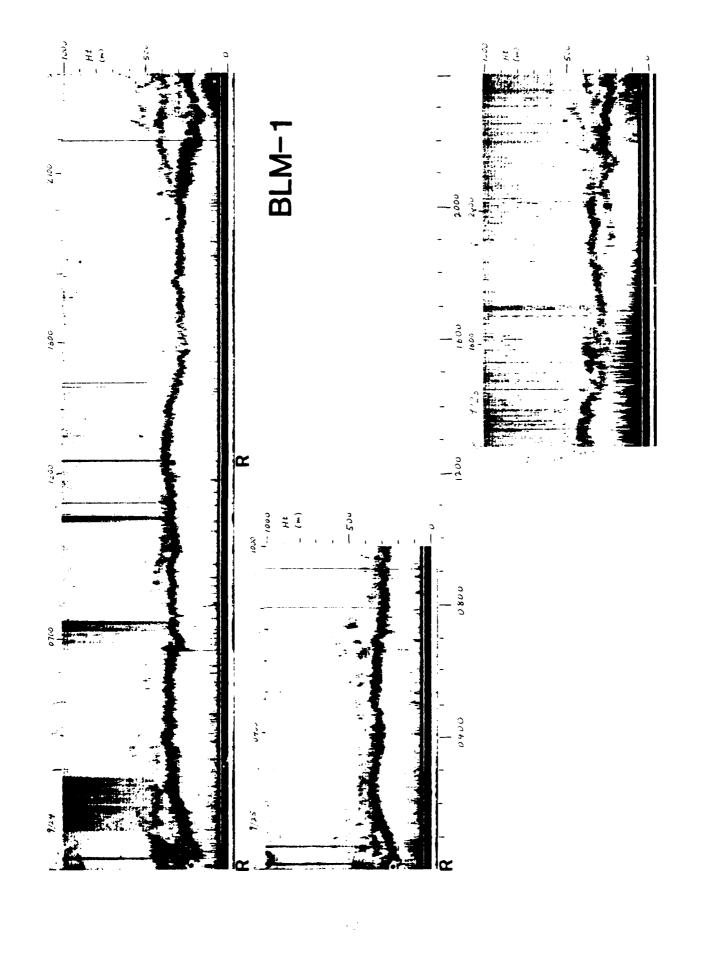
Photographs of the acoustic sounder strip chart outputs are presented in Figures 11. The dark bands on the charts are due to the increase in ambient noise that occurs when the ship is in motion. Small black or white dots on the photographs show the heights of the base of the temperature inversions as determined from the radiosondes.

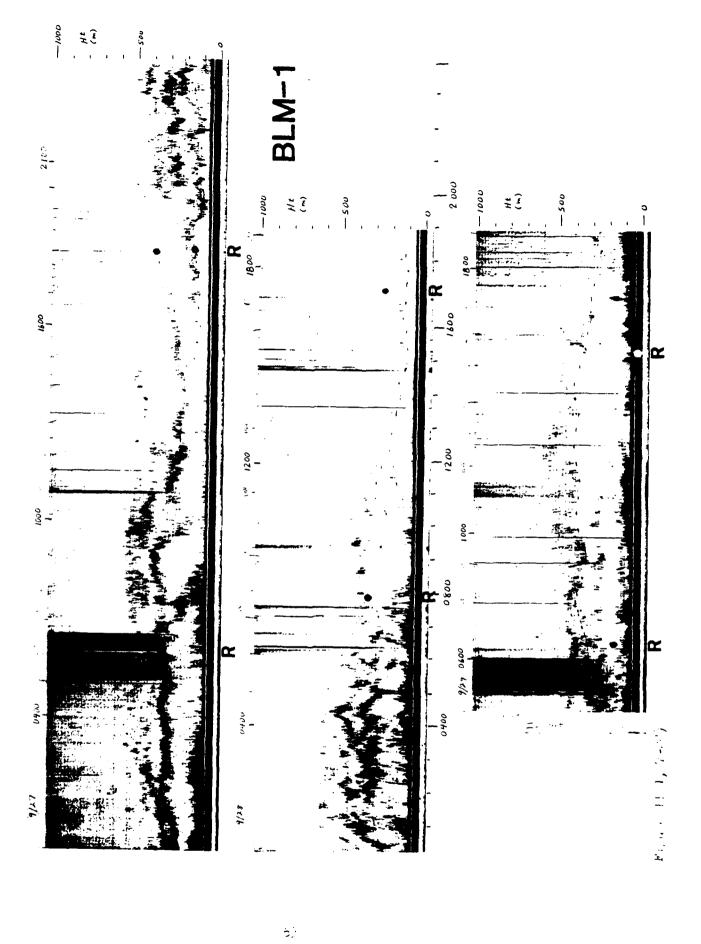
It is not easy to interpret these data from the photographs in Figure 9. Thus, tables of the heights of the acoustic echo returns, averaged for each half-hour, are given in Tables 6a-d.

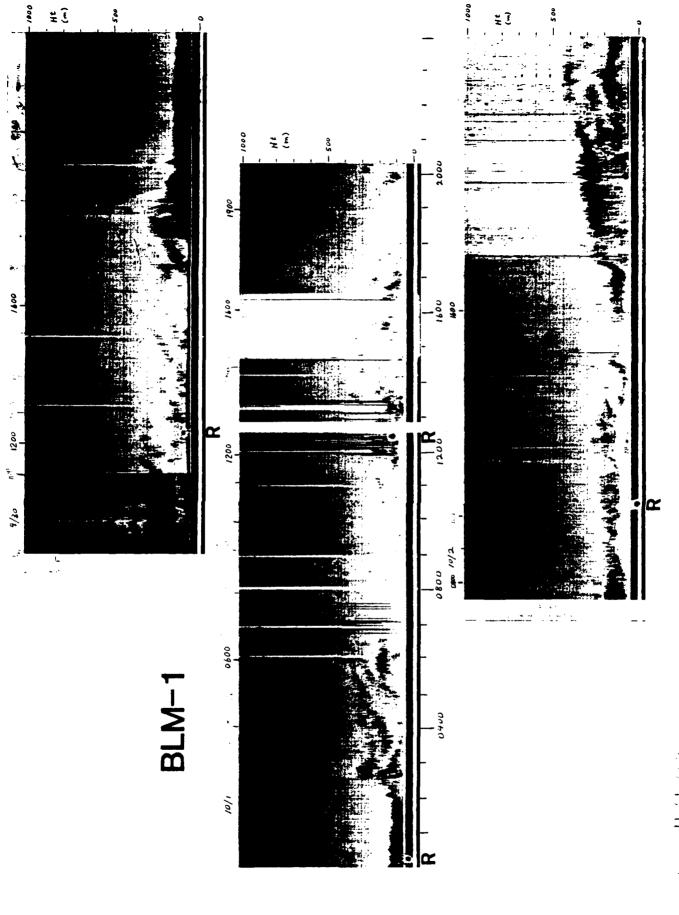
The boundary layer depths, as determined from the radiosondes, are given in Table 7. Examination of the radiosonde profiles, Figures 12, shows that the potential temperature and water vapor mixing ratio do not always identify the same height for the boundary layer. In many such cases the discrepancy is due to the poor response of the radiosonde relative humidity sensor when leaving the top of a cloud. In such cases we rely on the temperature sensor to identify the boundary layer height.

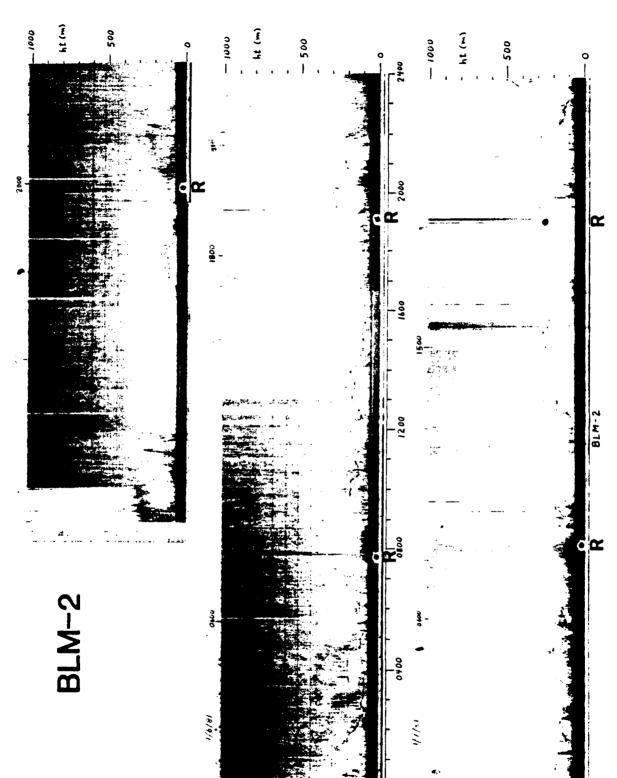
Several returns can occur at one time, one of which may be the height of the base of the inversion. We arbitrarily assign the return heights as  $Z_1$ ,  $Z_2$ , or  $Z_3$  in the tables. The only rationale in the assignment is to make it possible to easily follow height changes with time in the table.



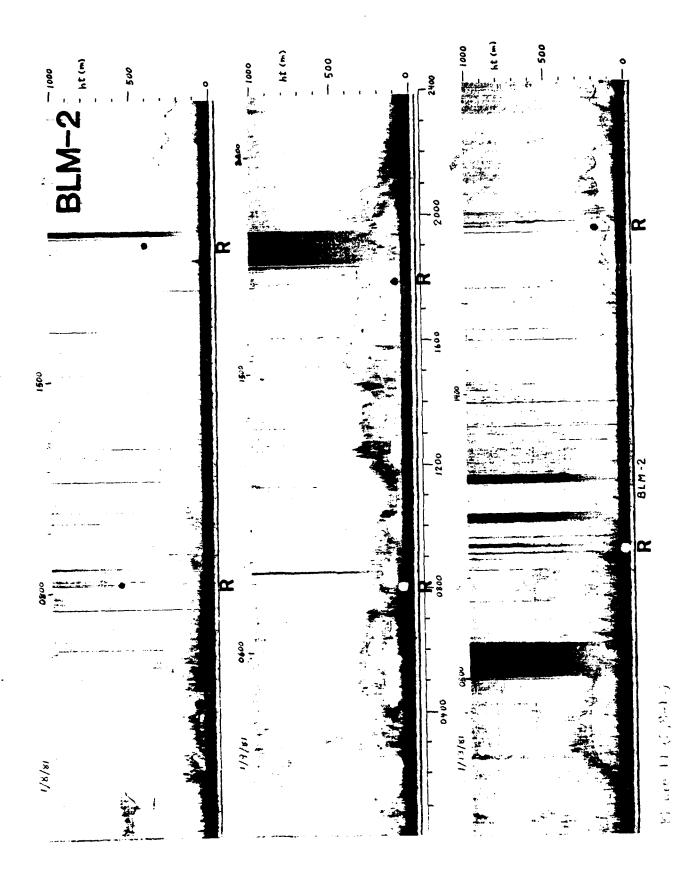


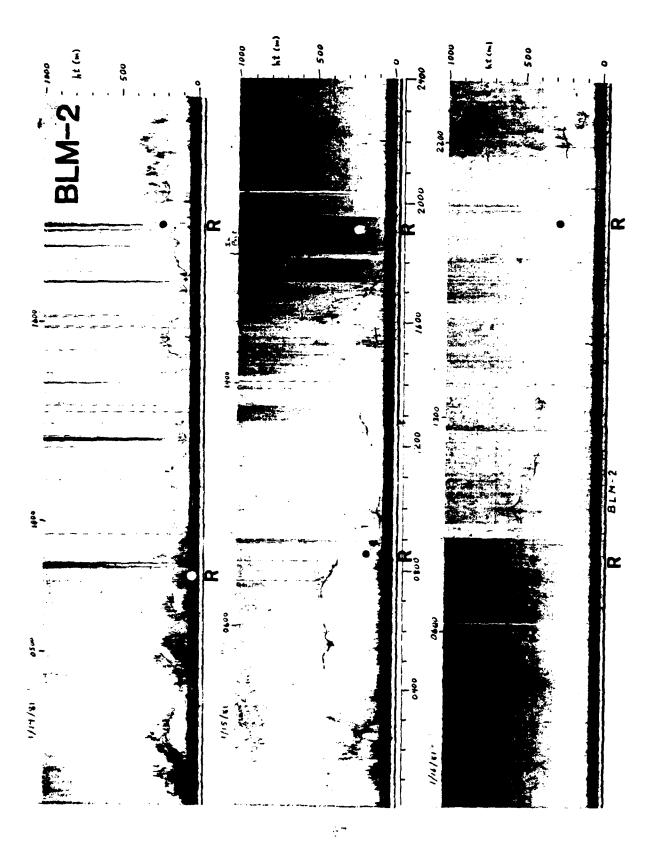






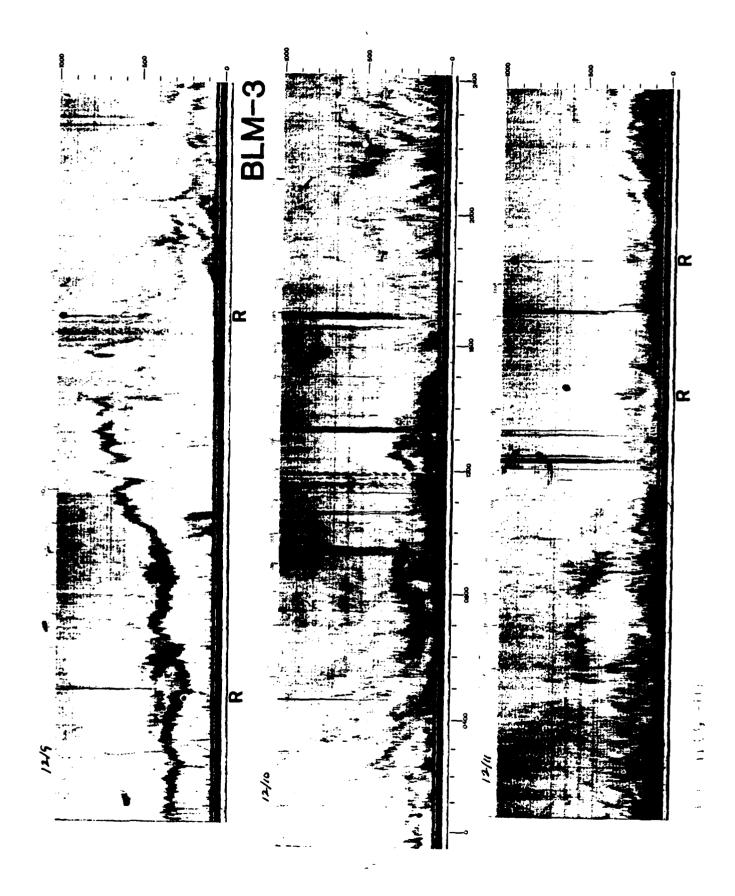
(3) 11 mm

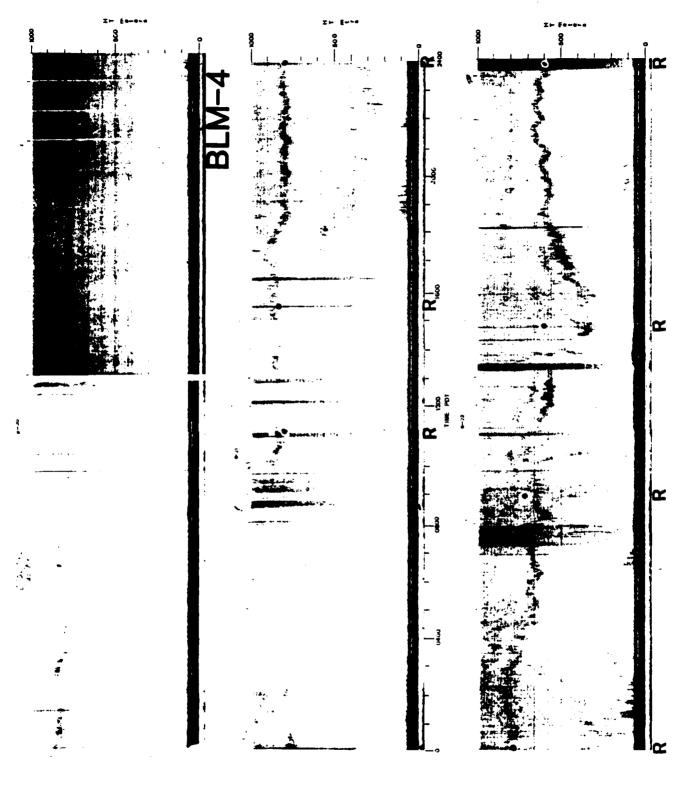




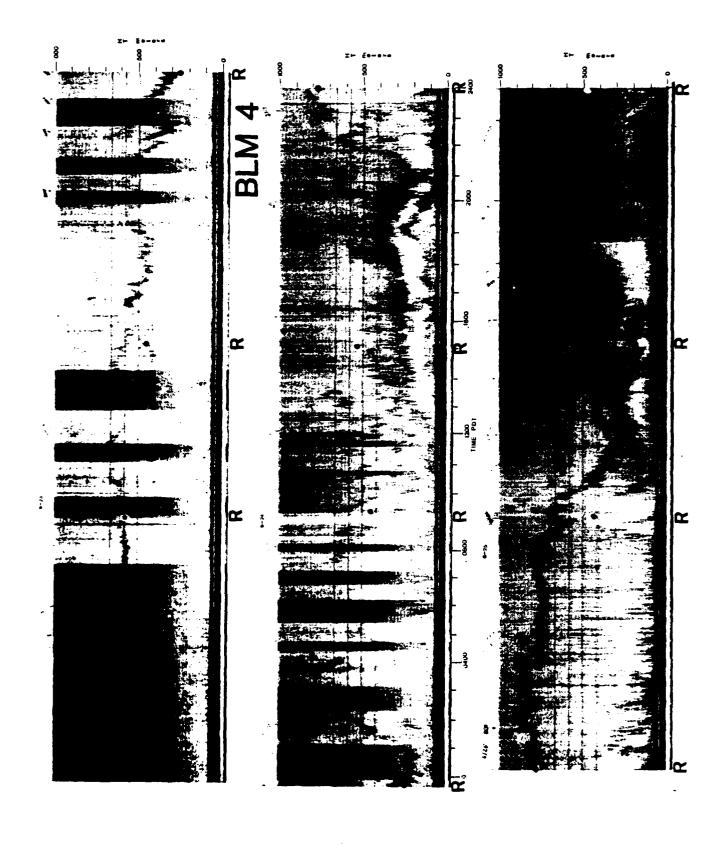
The state of the state of



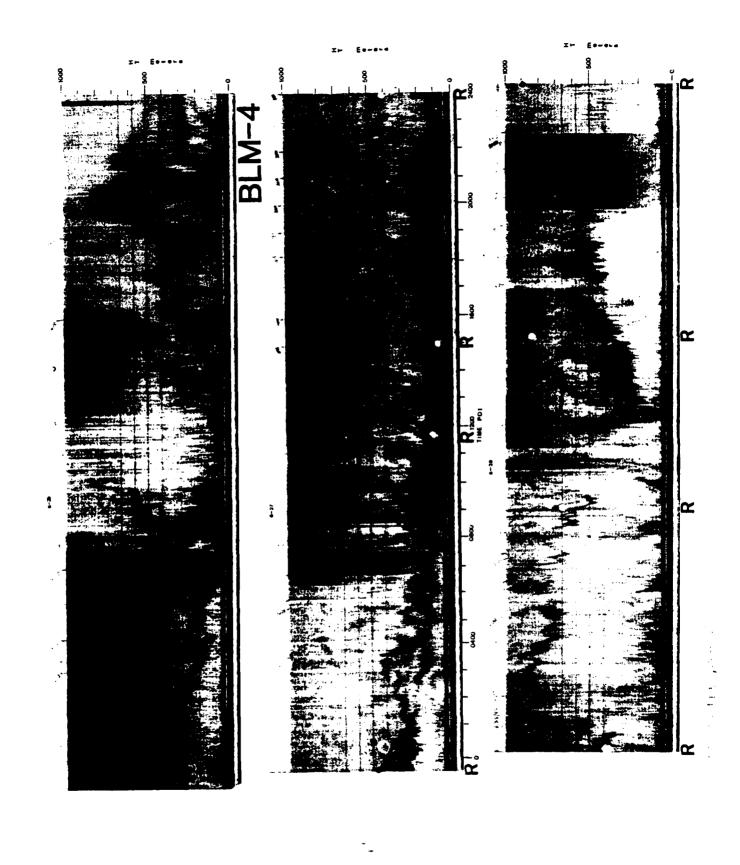




Contract to the second



•



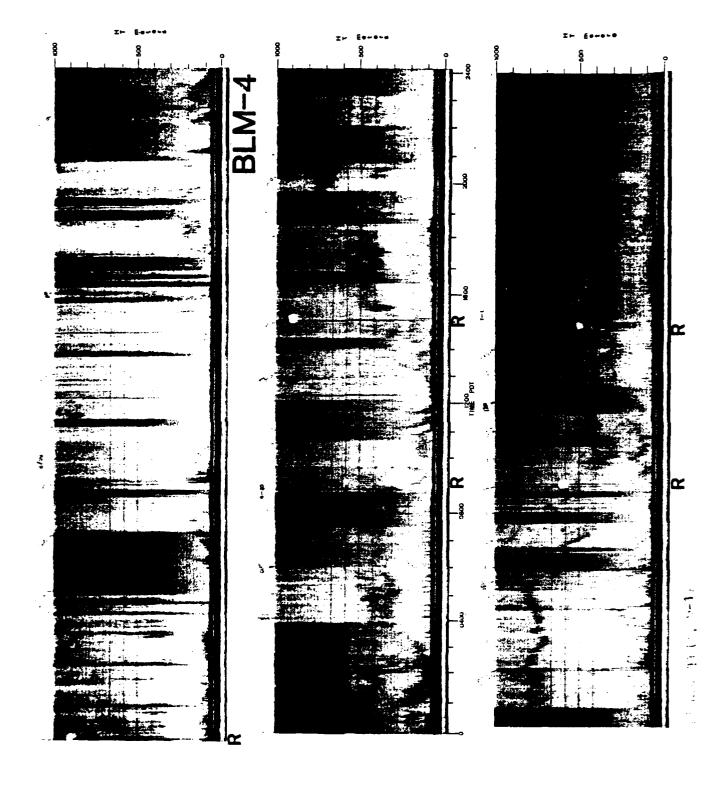


Table 6a. Heights from which acoustic echos were detected from the acoustic sounder for BLM-1.

		heig	ht(m)			heigh	t(m)
DATE	TIME	Z <sub>1</sub>	Z <sub>2</sub>	DATE	TIME	Z <sub>1</sub>	$z_2$
09/21	0900	_ 0		9/22	1700	260	
	1130	0			1730	310	
	1200	90			1800	320	
	1230	120			1830	340	
	1300	100			1900	280	
	1330	70			2000	360	
	1500	60		J	2030	370	
	1530	70		]	2100	360	
	1600	70		l	2130	400	
	1630	0		\	2200	370	
	1730	0	160	l ———	2230	380	
	1800	0	210		2300	300	
!	1830	80	260		2330	330	
	1900	120			2400	320	
l	1930	180		- 0 /23	0030		
l ————	2000	240		9/23	0030	340	
[	2030	300			0100	340	
	2100	340		l ———	0130	330	
1	2130	290			0200	310	
	2200	190		l ————	0230	320	
	2230	300			0330	$\frac{320}{330}$	
	2300				0400	320	
	2330	340		l ———	0430	$\frac{320}{310}$	
	2400	380			0500	320	
0.733	0030	400			0530	330	
9/22	0100	430		l ————	0600	310	
l ————	0130	450			0630	320	
l ————	0130	350			0700	300	
	0200	220			0730	320	
	0230	$\frac{220}{190}$		I — —	0800	310	
	0300	160			0830	340	- <del></del>
	0330	140			0900	330	
\ <del></del>	0400	80			0930	340	
	0600	0		l ———	1000	320	
	0630	280		l ———	1030	310	
	0700	$\frac{200}{320}$			1100	330	
	0730	$\frac{-320}{410}$			1130	340	
	0800	460		I	1200	350	
	0830	500		\ ———	1230	360	
	0900	520			1300	370	
	0930	550			1330	350	
	1000	560		-	1400	330	
	1030	570			1430	310	
	1100	580			1500	320	
	1130	140	580		1530	330	
	1200	230	590		1600	310	
	1400	1			1630	300	
	1430	220	520		1700	290	
	1500	220	450	1	1730	280	
	1530	240	410		1300	260	
	1600	210			1330	270	
	1630	270	<del></del> i		1900	290	
''				1		:	

		height	(m)			heig	ht(m)
DATE	TIME	21	$z_2$	DATE	TIME	21 ]	$z_2$
9/23	1930	300		9/24	2130	210	
	2000	290			2200	170	
	2030	310			2230	160	
	2100	300			2300	130	
	2130	240			2330	<u>200</u>	
	2200	210					
	2230	200		9/25	0000	$-\frac{1}{220}$	
	2300	180		- 9/23	0030	$-\frac{220}{210}$	
	2330	200			0100	$\frac{-210}{230}$	
	2330	200					
					0130	290	
9/24	0000	210			0200	310	
	0030	190	390		0230	330	
	0100	230			0300	320	
	0130	250		<u> </u>	<u> </u>	300	
	0200	270			0400	290	
	0230	300			0430	300	
	0300	310			0500	320	
	0330	320			0530	310	
	0400	340			0600	300	
	0430	320		l	0630	290	
	0500	330		<b>│</b>	0700	240	
	0530	340			0730	270	
	0600	$\frac{340}{320}$		l	0300	250	
	0630	$\frac{320}{310}$			0830	$\frac{-230}{270}$	
		$\frac{310}{290}$				260	
	0700				0900		
	0730	310			0930	250	
	0800	320		l	1000	240	
	0830	310		l			
	0900	320		]			
	0930	310	]				
	1000	300		]			
	1030	330					
	1100	320		9/26	1300	350	
	1130	330			1330	350	380
	1200	350		1 1	1400	360	
	1230	360			1430	310	
	1300	340		{ <del></del> -	1500	280	
	1330	350			1530	300	
	1400	340			1600	240	340
	1430	310			1630	$\frac{210}{270}$	
	1500	$\frac{-310}{230}$			$-\frac{1000}{1700}$	$\frac{270}{230}$	
	1530	270			<del>1700</del>	$-\frac{230}{230}$	
	1600	$\frac{270}{250}$			1800	300	
		$\frac{250}{270}$				$\frac{300}{320}$	
	1630				1330		
	1700	230			1900	330	
	1730	270			1930	310	
	1300	230		<b> </b>	2000	240	330
	1330	270			2030	250	
	1900	230			2100	220	
	1930	270			2130	240	
	2000	260			2200	230	
	2030	240			2230	210	
	- 5136 -	220					
;							

U

• • •

DATE	TIME	Z <sub>1</sub>	$\mathbf{z}_2$	DATE	TIME	1 21 1	$\mathbf{z}_2$
9/27	0000	200		9/28	0200	$\frac{z_1}{280}$	
	0100	210		1 - 3/20	0230	250	
	0130	220			0300	260	
	0200	250			0330	270	
	0230	240		1	0400	$\frac{270}{260}$	
	0300	260			0430	$\frac{200}{270}$	
	0330	250		l	0500	$\frac{270}{250}$	
<del></del>	0400	$\frac{250}{260}$		l	0530	230	
	0430	$-\frac{200}{270}$			0600	{	
	0500	250			0630	200	
	0530	$-\frac{230}{270}$			$\frac{-0830}{0700}$		
	0600	$\frac{270}{270}$			0730	ł <del></del> -	
	0530	290			0800		
l	0700	200		\	0830	{{	
	0730	$\frac{200}{180}$	230		0900	ł	
	0300	$\frac{100}{300}$	$-\frac{280}{400}$		0930	<del>-250</del>	
<del></del>			1				
	0830	330 340	440		1000	230 240	
	0930				1030		
		280	400		1100	300	
	1000	160	380	1	1130	290	
	1030	180	380		1200	260	
	1100	240			1230	210	
	1130	230			1300	200	
	1200	210			1330	170	
	1230	240			1400	150	
	1300	230			1430	160	
	1330	210			1500 1530	120	
	1400	200		1		110	
	1430	210			1600	120	
	1500	140	230		1630	140	
	1530	130	240		$\frac{1700}{1730}$	130	
	1600	110	250			120	
	1630	120	270		1300	110	
	1700	110	290 340		1330 1900	130	
	1730	130	360	l	1900	<del>-</del>	
	1800	140	300			li	
	1330	150				<b></b>	
		160				<del>-</del>	
	1930	120					
	2000	100				┨	
	2030	110	220			l ————	
! <del></del>	2100	90	230			·	
	2130	220	250			ll	
	2200	240	260	1-2755			
	2230	230	270	9/29	0430	240	<del></del>
	2300	250	290		0500	200	280
	2330	200	289		0530	240	
					0600	310	
9/23	0000	200			0630	320	
İ	0030	230			0700	350	
	0100				0730	330	
i	0130	<b> </b>			0300	390	
1	0200	290		! !	0330	360	

		neigi				II-19	nt (m)
DATE	TIME	Z <sub>1</sub>	$z_2$	DATE	TIME	7-	z <sub>2</sub>
		- <del></del> +				$\frac{z_1}{240}$	
9/29	0900	340		10/2	2030	240	
1	0930	360			2100		
	1000	380			2130		
	1030	30	400		2200	110	
			400		2200		
	1100	330		ļ .	2230	140	
	1130	30	370		2300	150	
	1200	400		·	2330	$\frac{-130}{130}$	
					2330	130	
	1230	410					
	1300	100	400				
	1330	80	390				
	1400	410		1073	0000	120	
				10/3			
	1430	420			0030	110	
	1500	330			0100	90	
	1530	340			0130	110	
	1600	330					
					0200	100	
	1630	310	1	į į	0230	130	
	1700	320			0300	140	
	1730	300		<del></del>	0330	150	
	1800	280			0400	170	
	1830	260			0430	160	
	1900	270			0500	120	
				<del></del>	0530	140	
				·			
9/30	No well	defined		]	0600	120	
10/1	Inver	sion			0630	130	
					0700	140	
					0730	100	
					0080	90	
10/2	0300	90					
10/2	0830	110		<b> </b>	<del></del>		
				1			
1	0900	140	İ				_ 1
	0930	130					
	1000	110					
				l —————			
	1030	120					
	1100	130		1			1
	1130	140					
	1200	150					
1 <u></u> ]	1230	140		1			
	1300	190					
	1330	120					
	1400	<del>- 120</del>		1			
<u> </u>	1430	100					
	1500	110					
	1530						
		<del>100</del>					
	1600	100					
	1630	110	- 1			·	
	1700	30					
<del></del>	1730						
	1300						
	1330	220					1
	1900	230					
		$\frac{230}{220}$					
	1930						
	2300	231)					
	· — — — — — —						

Table 6b. Heights from which acoustic echos were detected from the acoustic sounder for BLM-2.

21/72	l	heigh <sup>Z</sup> l	<sup>z</sup> <sub>2</sub>	1 I		heigh Z <sub>1</sub>	Z
DATE 1/6	1230	120		DATE 1/8	<u>TIME</u>		) <del>-600</del>
1/6	1300			1/0	2000	330	7-600
	1330	140		I	2100	320	
		140		l	$\frac{2100}{2200}$		
	1400	160		\		320	
	1700	180			2230	240	
	1730	180			2300	270	
	1800	240			2330	360	
	1830	160		1			
	1900	300		1/9	0430	200	
	1930	280		]	0500	190	
					0530	200	300
	2000	300			0600	200	300
	2030	200			0630	160	240
	2100	200			0730	250	
	<b> </b>			l	0800	160	
	l			l	0830	200	
	<b> </b>			l			
				l	0900	160	
1/7	0200	140			1000	160	
	0600	120			1030	100	
					1100	100	
	0900	120			1130	100	
	1100	80			1200	120	
	1130	80			1230	140	
	1200	80			1430	100	
	1230	100	180		1530	260	
	1300	200			1600	360	
	1500	250			1630	140	300
	1530	260			1700	180	340
	1600	200			1730	300	
	1730	160			1800	260	
	1						
<del></del>	1930	300			1900	80	160
	2000	300		1	1930	200	
	2130	400			2000	160	
	2200	280		1	2030	120	280
	2230	160	450		2100	120	
	2300	120					
<del></del>	2330	340		1/13	0200	160	
	2400	440		]	0230	220	
	\ <del>- 2300</del>				0300	260	
	·	·		i	0330	250	
1/8	0030	520		I	0400	260	<del></del>
	0100	500			0430	240	
	0130	540		1	0500	220	
	0130	100		<del></del>	0800	180	500
	0230	140				<del></del>	
	0300	80			1300	100	
					1830	130	
	0330	100		<del></del>			
	0400	100			1900	120	
	0530	260			1930	100	
	0830	180			2000	140	
	1	l í	•	1	;	i	

height(m) | Z<sub>1</sub> | Z<sub>2</sub>

height(m)

DATE	TIME	<sup>z</sup> 1	<sup>Z</sup> <sub>2</sub>	DATE	TIME	$z_1$	<sup>2</sup> 2
1/13	2030	160		1/15	1200	120	
	2100	200			1230	160	
	2130	180			1300	200	1
	2330	180			1530	100	
					1600	350	
1/14	0130	100			1630	260	
	0200	180			1700	150	
l ————	0230	180					
	0300	160		-			
<del></del>	0400	80	<del></del>	1/16			
	0500	100		\ <del>/</del>	1000	550	
	0630	160	·	·	1130	400	
				<del></del>	1330	360	
	1000	200	<b></b>				
	1100	170			2200	220	
	1130	160			2230	160	260
	1200	100		<del></del>	2300	100	
<del></del>	1230	80		l ———	2330	180	
	1300	100	<del></del>	l ————			
	1400	180					
	1500	200		<del></del>			
<del></del>	1600	160		ł <del></del>			
	1700						
		80				<del></del>	
	1730	80	·	l ———			
	1800	160		l ———			
	1830	120					
	1900	160					
	2000	200					
	2030	230					
	2100	220					
	2130	160	240				
	2200	200	300				
	2230	210	300		-	_	
	2300	300					
	2330	190					
	<del>- ~~</del>	<del></del>					l
1/15	0100	350					<del></del>
	0130	260			-		l
	0200	180					
	0230	160				·	·
	0300	100	300		-		<del>-</del>
	0330	300					
	0400	420					{
	0500	420		1			{
	0530	360					ł
	0600	400			<u> </u>		l ————
	0700	460			<u> </u>		
	0730	450					l
	0800	380					}
	0830	340					
							ll
	0930	140				]	J
		· <del></del>					

: -

Table 6c. Heights from which acoustic echos were detected from the acoustic sounder for BLM-3.

		_ heigh	it (m)			_ heigh	nt (m)
DATE	TIME	$Z_1$	$z_2$	DATE	TIME	$Z_1$	$z_2$
12-6-81	0900	1			1230	300	
	0930				1300	350	
	1000	[ <del></del>			1330	290	
	1030				1400	245	
	1100				1430	200	
	1130	480		(	1500	190	
	1200	420			1530	160	
	1230	360	70		1600		
	1300	350	90		1630		
	1330	320	100		1700		
	1400	<del></del>	100		1730		
	1430	(	110	·	1800		
	1500	ii	110		1830	170	<del></del>
	1530	l ————	100		1900	180	
	1600	l	120		1930	160	
	1630	l ———	130		2000	150	
	1700	360			2030	170	
	$\frac{1700}{1730}$	320			2100	160	
	1800	330			2130	170	
	1830	360			2200	190	
	1900	380			2230	190	
	1930	350			2300	250	
	2000	240			2330	230	
	2030	180			2400		
	$\frac{2030}{2100}$	140		12-8-81	0030	120	
		250		12-0-01			- 330
	2130	$\frac{230}{220}$			0100	130	230 170
	2200 2230	180			0200	130	
		150				160	
	2300 2330				0230		
12 7 01		140 160			0300	180	
12-7-81	0000				0330	150	
	0030	160			0400	130	
	0200	200			0430	150	
	0230	230			0500	160	
	0300	170			0530	150	
	0330	220			0600	120	
	0400	180			0630	150	
	0430	140			0700	130	
	0500	اا			0730		
	0530	260			0800		
	0600	220			0830		
	0630	240			0900		
	3700	210			0930	340	
	0730	170			1000	350	
	0800	160			1030	330	
	0830	210			1100		
	0900	250			1130		
	0930	280			1.200	300	
	1000	240			1230	260	
	1030	200			1300	210	
	1100				1330	220	
	1130	225			1400	220	
	1200	240			1430	230	

height(m)

DATE	1 IME	<sup>z</sup> 1	<sup>z</sup> <sub>2</sub>	DATE	TIME	z <sub>l</sub> i	z_
12-8-81	1500	250			1730	230	360
	1530	210			1800	260	360
	1600	200	<del></del>		1830	270	
	1630	210		1	1900	250	80
<del></del>	1700	170	300		1930	270	200
	1730	160	320	I ———	2000	340	160
	1800	150	280		2030	300	140
	1830	140	290		2100	340	580
	1900	140	280		2130	240	570
	1930	310		I ———	2200	280	520
	2000	290			2230	290	450
	2030				2300	300	200
	2100	l ———			2330	310	170
	2130				2400	250	130
	2200	80		12-10-81	0030		140
	2230	125		1	0100		130
	2300	110	260		0130	240	
	2330	120	280	l ———	0200	340	
	2400	200	350	l	0230	290	
12-9-81	0030	290	<del>- 330-1</del>	]	U300	270	
12-9-61	0100	280		l	0330	190	
	0130	240		l ———	0400		
	0200	290			0430	340	
	0230	$\frac{290}{270}$			0500	250	
	0300	280		l	C530	190	
					0600	150	
	0330	310			0630	110	
	0400 0430	290 250	· ————————————————————————————————————	]	0700	$\frac{110}{120}$	
	0500				0730	150	
		200			0800	210	
	0530	220			0830	$\frac{210}{200}$	
	0600	240		l			
	0630	310			0900		
	0700	350			1000		
	0730	330			1030		
	0800	320 310			1100		
	0830				1130	<del> </del>	
	0900	330			1200	190	<del></del>
	0930	360		I			
	1000	410			1230	$\frac{240}{230}$	
	1030	540	<b></b>		1300		
	1100	600			1330	100	
	1130	540					
	1200	640		I	1430		
	1230	660			1500		
	1300	680		l ———	1530		
	1330	500	680		1600		
	1400	430	720		1630		
	1430	440	700		1700		
	1500	430	780		1730		
	1530	425	750		1800		
	1600	380	500		1830	410	
	1630	350	440		1900	420	
	1700	310	460		1930	440	

DATE	TIME	z <sub>1</sub>	z_	DATE	TIME	<sup>Z</sup> 1	$\mathbf{z_2}$
12-10-81	2000	490			2230	400	
	2030	510			2300	380	
	2100	490			2330	320	
I ———	2130	460			2400	340	
	2200	430		12-12-81	0030	420	310
	2230	440		1	0100	430	320
l ————	2300	380		<del></del>	0130	450	330
i ———{	2330	390			0200	440	320
	2400	340	<del></del>	<del></del>	0230	440	280
12-11-81	0030				0300	450	260
1 =====================================	0100			<del></del>	0330	430	260
l ———	0130		<del>  </del>	<del></del>	0400	400	260
	7200	<del></del>			0430	370	
l ———	0230				0500	350	
·	0300				0530	330	
	0330			<del></del>	0600	300	
l ————	0400				0630	310	
l ————	0430	510	<del></del>	I ———	0700	320	
	0500	460			0730	280	
l ————	0530	460		<del></del>	0800	250	
l ————	0600	470				230	
l ———				l	0830 0900	230	
	0630 0700	490				100	
		480			0930	100	
	0730	460			1000	120	
	0800	480			1030	140	
l ————	0830	420			1100	100	
l ————	0900	360		l ———	1130	·	
l ————————————————————————————————————	0930	420			1200	450	
·	1000	430		l ————	1230	200	700
	1030	370			1300	140	450
]	1100	350			1330	200	340
	1130	340			1400		
	1200				1430		
	1230			<del></del>	1500		
	1300				1530		
	1330	100			1600		
l ———	1400	160			1630		
	1430	140			1700		
	1500			l	1730		
	1530				1800		
	1600				1830		
	1630				1900		
	1700				1930		
	1730			l ———	2000	420	
	1800				2030	500	
	1830	180			2100		
	1900				2130		
	1930	200			2200	700	
	2000	230		1	2230	650	
	2030	210		1	2300	600	
	2100	220			2330	580	
	2130	260			2400	580	
	2200	350		12-13-81	0030	580	

height(m) Z

DATE	TIME		z	DATE	TIME	l <sup>z</sup> ı l	<sup>z</sup> 2
12-13-81	0100	580	<del></del>		0330	200	
	0130	580			0400	220	400
	0200	540			0430	180	
	0230	460			0500	160	250
	0300	450			0530		
<del></del>	0330	580			0600	140	
	0400	580			0630		
l <del></del>	0430	540		<del></del>	0700		
	0500	480		<del></del>	0730	-	
	0530	420			0800		
	0600	430			0830	300	
	0630	420		1	0900		
<del></del>	0700	390		<del></del>	0930	400	
	0730	380	<del></del>	<del></del>	1000	<del></del>	
	0800	400		<del></del>	1030	220	
	0830	380		l ————	1100	240	
	0900	350		·	1130	300	
	0930	320			1200		
	1000	280		i ———	1230		
	1030	320	160	I	1300		
	1100	330	130	<del></del>	1330		
<del>  </del>	1130	300	100		1400		
	1200	260	120		1430	<del></del>	
	1230	250	160	<del></del>	1500	·	
l ———	1300	200	160	<del></del>	1530		
	1330	250	180		1600	200	
	1400	280	120		1630	200	
	1430	240	60	l ————————————————————————————————————	1700		
	1500	150			1730	200	
	1530	120			1800		
	1600	130		<del></del>	1830	230	
	1630	1 <del>  </del>		<del></del>	1900	250	
	1700	280			1930	320	210
	1730				2000	340	
	1800	400		l ——	2030	380	
	1830				2100	320	
	1900	340			2130	280	
	1930	280			2200	320	100
	2000	420			2230		140
	2030	1			2300	200	
	2100	1			2330	320	
	2130	1			2400	340	
	2200	240		12-15-81	0030	310	
	2230	160			0100		
	2300	140			0130	330	
	2330	100			0200	300	
	2400	1			0230	240	
12-14-81	0030	210			0300	280	200
	0100	170			0330		200
	0130	140			040C	300	140
	0200	240			0430		
	0230	]			0500	220	
	0300	250			0530	160	
·				· ———		' ———	<del></del>

height(m)

DATE	TIME	<sup>Z</sup> 1	<sup>Z</sup> 2	DATE	TIME	$\mathbf{z_1}$	$^{\rm Z}_2$
12-15-81	0600	140	500		0830	240	
	0630	120	400	1	0900		<del></del>
	0700				0930		
	0730				1000		
	0800				1030		
	0830		90		1100		
	0900		120		1130	80	
	0930		160		1200	170	
	1000	300	140		1230	270	
	1030	340	100		1300		
	1100	360	150	1	1330		
	1130	390	200	I	1400	110	
	1200			I	1430	150	
	1230			I	1500	160	
	1300	<del></del>		<del></del>	1530		
	1330			]	1600		<del></del>
	1400	400			1630		
	1430	<del></del>			1700	140	
	1500				1730	130	
	1530			<del></del>	1800	220	
	1600	380		1	1830		
	1630	-300			1900	160	
	1700				1930	100	
	1730	220			2000	100	
	1800		~	I	2030	140	
	1830				2100	140	
	1900	320			2130		<del></del>
	1930	310			2200	250	130
	2000	320		<del></del>	2230	270	
	2030	320			2300	290	
		210		I	2330		
	2100	210		1			
	2130			12 17 01	2400		
	2200			12-17-81	0030		
	2230	-350-		<del></del>	0130		
	2300	250			0200	-100-	
	2330	140		l ————		100	
12 16 91	2400	140			0230	100	320
12-16-81	0030			l ———	0300		340
	0100				0330		
	0130	150			0400	140	396
	0200	150			0430	140	280
	0230			·	0500		300
	0300	1 <del>- 1 7 -  </del>		1	0530	100	380
	0330	170			0600	100	270
	0400	\ <del>- 1</del>			0630	120	300
	0430	160		1	0700		280
	0500	<del></del>			0730		
	0530	230			0800		
	0600	<del></del>		1	0830	-130	
	0630			1	0900	180	<del></del>
	0700				0930		
	0730				1000		
	0800	240		1	1 0 30		

height(m)

DATE	TIME	<sup>2</sup> 1	<sup>2</sup> 2	DATE	TIME	$z_1$	<sup>2</sup> 2
12-17-81	1100	80				-	
	1130	100					
	1200	120					
	1230	170					
	1300	230					
	1330	220					
	1400	230					
	1430	190					
	1500	180					
	1530	170					
	1600						
	1630	80					
	1700	90					
	1730	120				-	
	1800	120					
	1830	160					
	1900	240					
	1930	280					
	2000	200					
	2030	160					
	2100	130					
	2130	140					
	2200						
	2230	200					
	2300	170					
	2330	160					
	2400	170					

Table 6d. Heights from which acoustic echos were detected from the acoustic sounder for BLM-4.

DATE/	he	ight (m)		DAGE /	hei	.ght (m)	
TIME	$\mathbf{z_1}$	<sup>Z</sup> 2	<sup>Z</sup> 3 l	DATE/	$z_1$	z <sub>2</sub>	<b>z</b> <sub>3</sub>
	<del></del>			TIME			
6/20/82		<del>- 360 -  </del>		6/21/82	140		
1300		260	750	1430	140		800
1330		230	760	1500	170		840
1400		220	770	1530	160		840
1430		260	780	1600	110		850
1500		260	770	1630	140		840
1530		210	760	1700		220	880
1600		210	760	1730		320	890
1630		260	770	1800		360	830
1700		210	750	1830		390	790
1730		220	770	1900		350	780
1800		210	760	1930		300	780
1830		230	770	2000		310	770
1900		270	770	2030		280	780
1930	200	J J	720	2100		270	780
2000	120	]	750	2130		270	780
2030	210		760	2200	150		760
2100	170		720	2230	200		760
2130	150		740	2300	220		790
2200			750	2330	160		790
2230			760	2400	140		780
2300			740	6/22/82			
2330			710	0030	170		790
6/21/82				0100	150		740
0000			720	0130	130		750
0030			740	0200	110		780
0100			760	0230	140		800
0130			760	0300	110		770
0200			760	0330	120		720
0230			760	0400	180		710
0300			750	0430	190		680
0330			740	0500	230		670
0400			710	0530	170		700
0430			710	0600	140		640
0500			730	0630	110		630
0530			700	0700	130		660
0600			700	0730	180		640
0630			660	0800		210	610
0700			670	0830		290	580
0730			720	0900		300	610
0800			760	0930		300	590
0830		1	760	1000		310	620
0900		1	780	1030		350	650
0930	90	1	820	1100		330	600
1000		200	850	1130		240	590
1030		240	820	1200	150		550
1100		170	820	1230			540
1130	80	1	790	1300			520
1200		1	800	1330			520
1230		1	810	1400		360	
1300		1	820	1430		33C	
1330		11	840	1500		313	
1400	100	1 <del></del> 1	330	1530		250	
1400				1 2 3 3 0			

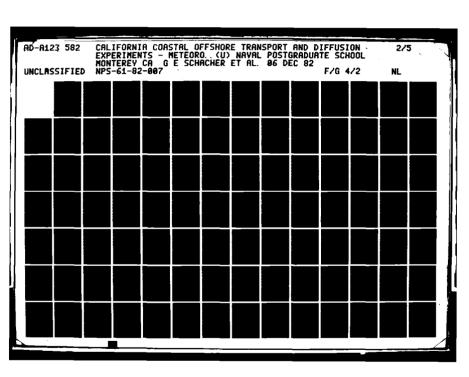
DATE/	h	eight (m)		DAME: /		height (m)	
TRE	l <sup>z</sup> ı	<sup>Z</sup> 2	<sup>z</sup> <sub>3</sub>	DATE/	_z <sub>1</sub>	$\frac{z_2}{}$	<sup>2</sup> 3
6/22/82		! <del></del>		6/24/82		<del></del>	
1600	<del></del>	300		0000		240	
1630	l ———	410		0030			
1700		430		0100			
1730		480		0130	100		
1800		480		0200	200	400	
1830	{ <del></del>	<del></del>	570	0230	110	<del></del>	590
1900	<del></del>		560	0300			620
1930		l	560	0330		i ———	600
2000		1	580	0400			580
2030	l ———		590	0430			520
2100			570	0500	100	400	
2130		l ————	640	0530	180	<del></del>	490
2200		l	610	0600			490
2230	<del></del>	1	620	0630	<del></del>		540
2300		<del></del>	610	0700	<del></del>		560
2330	<del></del>		590	0730			560
2400		1		0800	<del></del>		520
		1		0830	180	420	
6/23/82				0900	200		580
0730		l ———	550	0930	200		500
0800		1	540	1000	180		480
0830	·	1	580	1030	170		480
0900	<del></del>	1	600	1100	150		500
0930	·		590	1130	220		500
1000	<del></del>	1	600	1200	200		520
1030		1	640	1230	100	280	550
1100		{	620	1300	200	300	600
1130	f	1	640	1330	180	300	680
1200		1	550	1400	190	340	640
1230	l ———	1		1430	220	390	600
1300	1	1		1500	240	400	600
1330		1	650	1530	220	400	670
1400	<b>———</b>		610	1600	200	400	710
1430			600	1630	220	380	730
1500			560	1700	230	340	730
1530		480		1730		200	740
1600		520		1800		280	763
1630		440		1830	100	340	T ~
1700		460		1900		240,330	
1730		440		1930	160	300, ++.	
1800		420		2000	કળ	240,45.	
1830		420		2030	130		<del>-</del> ,
1900		490		2100	100		-
1930			560	2130			_
2000			500	2200			
2030			500	2300			
2100		480		2330	- 01		
2130		360		2400	:		
2200		240		o 25 32			
2230		400		Ju 30			
2300		410		, , , ,			
2330		320					

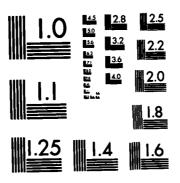
ľ

F

F

**5**"





MICROCOPY RESOLUTION TEST CHART NATIONAL BUREAU OF STANDARDS-1963-A

Time	DATE/		height (m)		. DATE/ .		height (m)	
6/25/82 (200)         850 (230)         6/26/82 (230)         220 (230)         220 (240)	•	l <sup>Z</sup> ı		Z <sub>3</sub>		$\mathbf{z_1}$		$\mathbf{z}_2$
\$\begin{array}{c c c c c c c c c c c c c c c c c c c			┪╼╼╌┪		6/26/82		<del></del>	
O230				850			220	<del></del>
0300 0330 0400 100         840 0500 100         0500 0530 160 0530 160 0600 170 0600 0630 0600 0630 0730 0600 0630 0730 07			<del> </del>					
0330			┨			160		
0400         100         700         0530         160           0500         720         0630         120           0530         710         0700         0730         100           0600         700         0730         100         0730         100           0700         740         0830         160         0730         160         0730         160         0730         160         0730         160         0730         160         0730         160         0730         160         0730         160         0730         160         0730         160         0730         160         0730         160         0730         160         0730         160         1000         100         100         160         1000         100		160	d ———				ł	
0430         730         0600         180           0530         710         0700         0630         120           0600         700         0730         100         000           0630         710         0800         200         00           0700         740         0830         160         0930         80           0800         100         710         0930         80         00         0930         80           0830         160         240         580         1030         80         00         0930         80         00         0930         80         00			l				l ————	
OSOO			┪╼━━┪				{ <del></del> -{	
0530 0600         710 700 0730         0700 0730         100 0800 200           0700 0730         740 0830         160 0830         160 120 0830         160 120 0830         160 120 0830         160 100 100 100         120 0930         100 100 100         120 0930         100 100         100 100 100         100		<del></del>	{ <del></del>			120	l	
0600         700         730         100         0800         200         0700         0730         160         0730         0730         740         0830         160         0730         0800         120         0900         120         0900         120         0930         80         0900         0900         240         580         1030         80         0900         0900         240         580         1030         80         00         0900         0900         240         580         1030         80         00         0900         0900         240         580         1030         80         00         <							l ————————————————————————————————————	
0630         710         0800         200           0730         720         0900         120           0800         100         710         0930         80           0830         160         670         1000         100           09900         240         580         1030         80           0930         270         660         1100         80           1000         160         380         1200         140           1100         160         320         1230         160         1300         180           11200         160         310         1330         180         1200         140         1330         140         1330         140         1330         140         1330         140         1330         140         1330         140 <t< td=""><td></td><td></td><td>┨</td><td></td><td></td><td>100</td><td>ł <del></del>i</td><td></td></t<>			┨			100	ł <del></del> i	
0700         0730         740         0900         120           0800         100         710         0930         80           0830         160         670         1000         100           0900         240         580         1030         80           1000         160         560         1100         80           1000         160         380         1200         140           1100         100         320         1230         160           1130         140         300         1300         180           1200         160         310         1300         180           1230         160         310         1330         240           1230         200         360         1400         220           1330         230         350         1500         160           1330         230         350         1500         160           1430         180         240,350         1600         270           1430         180         240,350         1600         270           1530         120         260         1700         180           1			{				l ———	
0730         100         720         0900         120           0830         160         670         1000         100           0900         240         580         1030         80           0930         160         560         1100         80           1000         160         560         1130         120           1030         90         380         1200         140           1100         100         320         1230         160           1130         140         300         1300         180           1200         160         310         1330         240           1230         200         360         1400         220           1330         230         350         1500         160           14400         220         370         1530         200           1530         120         280,320         1630         220           1530         120         280,320         1630         220           1530         120         260         1700         180           1630         120         260         1800         160           1							<del></del>	
0800         100         710         0930         80           0930         160         670         1000         100           0930         240         580         1030         80           0930         160         560         1100         80           1030         90         380         1200         140           1130         140         300         1300         180           1200         160         310         1300         180           1230         200         360         1400         220           1300         230         1430         160         130           1300         230         1530         160         130           1330         230         350         1530         200           1440         220         370         1530         200           1430         180         240,350         1600         270           1530         120         280,320         1630         220           1530         120         270         1700         180           1600         120         260         1800         180           170			<del> </del>				l ———-	
0830         160         240         580         1000         100           0930         270         660         1130         80           1000         160         380         1200         140           1100         10         320         1200         140           1130         140         300         1300         180           1200         160         310         1330         240           1230         200         360         1400         220           1330         230         350         1500         160           1330         230         350         1500         160           1330         230         370         1530         200           1430         180         240,350         1600         270           1500         120         280,320         1630         220           1530         120         280,320         1630         220           1530         120         260         1730         280           1600         120         260         1800         160           1730         260         1800         160         191 <td></td> <td>100</td> <td>┥</td> <td></td> <td></td> <td></td> <td>ł <del></del>∤</td> <td></td>		100	┥				ł <del></del> ∤	
0900         240         580         1030         80           0930         160         560         1100         120           1030         90         380         1200         140           1100         100         320         1230         160           1130         140         300         1330         180           1200         160         310         1330         240           1230         200         360         1400         220           1330         230         350         1430         160           1330         230         350         1530         160           1400         220         370         1530         200           1440         120         280,320         1600         270           1530         120         280,320         1630         220           1530         120         280         1700         180           1600         120         280         1830         160           1700         280         1830         160         170           1830         120         260         1830         160           1			ł ———				l	
0930         160         270         660         1100         80           1030         90         380         1200         140           1100         100         320         1230         160           1130         140         300         1300         180           1200         160         310         1330         240           1330         230         360         1430         160           1330         230         350         1500         160           1440         220         370         1500         160           1440         220         370         1500         160           1430         180         240,350         1600         270           1500         120         280,320         1630         220           1530         120         260         1700         180           1600         120         260         1800         160           1700         280         1830         160         200           1830         160         1930         300         300           1830         160         200         360         200			240					
1000							<del></del>	
1030		160	1 <del>- 270 - 1</del>				<del></del>	
1100			300	-300			{ <del></del> -	
1130								
1200							<del></del>	
1230         200         360         1400         220           1300         230         350         1500         160           1400         220         370         1530         200           1430         180         240,350         1600         270           1500         120         280,320         1630         220           1530         120         270         1700         180           1600         120         260         1730         280           1630         120         260         1800         160           1700         280         1830         160         1700           1800         1900         200         540           1830         2000         540         500           1930         160         2100         540           2000         140         2130         380           2030         90         2200         360           2130         120         2300         340           2230         90         640         2300         340           2230         90         640         2400         360           2							{ <del></del> {	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								
1330         230         350         1500         160         270           1430         180         240,350         1600         270           1500         120         280,320         1630         220           1530         120         260         1730         280           1630         120         260         1800         160           1700         280         1800         160           1730         260         1900         200           1800         1930         300           1830         2000         540           1930         160         200         540           1930         160         2100         440           2000         140         2130         380           2030         90         2200         360           2130         120         230         340           2230         90         640         240         360           2330         90         640         240         360           2330         90         640         240         360           2230         90         640         240         360			360				<del></del>	
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$							————	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						200	<del></del>	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						220	270	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			280,320				l ———	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						180	<del></del>	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$							280	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		120					————	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			260			200		
1900         100         2030         500           1930         160         2100         440           2000         140         2130         380           2030         90         2200         360           2130         120         2300         340           2230         90         640         2400         360           2330         120         600         6/27/82         360           2330         60         420         600         6/27/82         240           2400         450         0100         240         240           6/26/82         0130         260         210,280           0030         500         0200         100         210,280           0030         0200         120         200,340			ļ			<del></del>	300	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			ł					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			<b>∤</b>					500
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			┦ ────					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			ł					
2130         120         340           2200         60         2330         70         360           2230         90         640         2400         360           2300         120         600         6/27/82         240           2330         60         420         0030         240           2400         450         0100         240           6/26/82         0130         260           0030         500         0200         100         210,280           0100         230         120         200,340			<del>ا ـــــــا</del>					
2200         60         2330         70         360           2300         120         640         2400         360           2330         60         420         600         6/27/82         240           2400         450         0100         240         240           6/26/82         0130         260         260           0030         500         0200         100         210,280           0200         120         200,340								
2230         90         640         2400         360           2300         120         600         6/27/82         240           2330         60         420         0030         240           2400         450         0100         240           6/26/82         0130         260           0030         500         0200         100         210,280           0100         0230         120         200,340			<b> </b>					
2300     120     600     6/27/82       2330     60     420     0030     240       2400     450     0100     240       6/26/82     0130     260       0030     500     0200     100     210,280       0100     90     480     0230     120     200,340			<b>.</b>			70		
2330     60     420     0030     240       2400     450     0100     240       6/26/82     0130     260       0030     500     0200     100     210,280       0100     90     480     0230     120     200,340							360	
2400     450     0100     240       6/26/82     0130     260       0030     500     0200     100     210,280       0100     90     480     0230     120     200,340			J	600			l	
6/26/82     0130     260       0030     500     0200     100     210,280       0100     90     480     0230     120     200,340		60						
0030         500         0200         100         210,280           0100         90         480         0230         120         200,340			450					
0100 90 480 0230 120 200,340							11	
0130 120 340 0300 100 260,280	0130	120	340		0300	100	200,280	
0200 340 0330 150 300								
0230 300 0400 140 270							270	
0300 280 0430 200	0300		280		0430	200		

TIME	DATE/		height (m)		Dame /	r	meight (m)	
6/27/82         0500         140         200         6630         190         760           0530         100         200         0700         160         660         700           0630         100         200         0800         710         700         700         700         700         700         700         110         0800         9800         710         700         700         700         700         100         9830         900         540         80         70         700         800         700         900	•			$\mathbf{Z}_{2}$	DATE/			Z <sub>2</sub>
0500		<u> </u>					<del></del>	<del></del>
O530		140	300			190	<del></del>	750
0600         180         230         0730         100         700           0630         100         200         0800         710         700           0730         110         160         0900         540         580           0830         100         240         1000         660         660           0900         100         1000         490         660           0930         120         1100         490         660           1030         240         1200         260         1130         400           1030         240         1230         90         200         1200         260         1130         90         270         1300         240         1230         90         200         1200         260         1400         1230         90         1400         240         1230         90         120								
0630         100         200         0800         580         580           0730         110         160         0900         580         580           0800         80         180         0930         490         660           0830         100         240         1000         660         660           0990         100         1030         480         490         660         660           0930         120         1100         490         490         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         490         1100         1100         490         1100         1100         1100         1100         1100         1100         1100         1100         1100         1100         1100         1100         1100         1100         1100         1100								
0700         110         160         0900         580           0800         80         180         0930         490           0830         100         240         1000         660           0900         100         1030         480         490           1000         80         1100         490         400           1030         240         1200         260         260           1100         240         1230         90         260           1130         90         270         1300         200         200           1200         120         240         1330         240         200         200           1200         120         240         1330         240					· ————————————————————————————————————	100		
0730         110         160         0900         490         540           0830         100         240         1000         660         660           0900         100         1030         480         660           0930         120         1100         490         490           1000         80         1130         490         490           1100         240         1200         260         1130         260           1130         90         270         1300         200         200         200           1230         120         240         1330         240 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>								
0800         80         180         240         660           0830         100         240         1000         660           0900         100         1030         480           0930         120         1100         490           1000         80         1130         400           1000         240         1230         90           1130         90         270         1300         200           1200         120         240         1330         240           1230         180         1400         240           1330         180         1430         240           1330         1500         290           1400         1530         340           1430         1500         290           1500         1630         340           1500         1700         430           1500         1730         390           1630         140         1800         440           1700         80         200         1830         450           1800         100         250         1930         430           1800         100			160					
0830         100         240         1000         660           0900         100         1030         480           1000         80         1130         400           1030         240         1200         260           1100         240         1200         260           1130         90         270         1300         200           1200         120         240         1330         240           1230         180         1400         240         240           1330         180         1400         240         240           1330         1500         290         290         290           1400         1530         340         400         290           1400         1530         340         460         420         430           1500         1630         460         420         430         460         420           1530         140         1700         430         460         440         440         440         440         440         440         440         440         440         440         440         440         440         440         440 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>490</td> <td></td>							490	
0900         100         100         1100         480           0930         120         1100         490         1130         400           1000         80         1200         260         260         260         1100         260         1200         260         1200         260         1200         <							490	-660
1000   80			-240				400	
1000								——-
1030			l ———					
1100         240         1230         90           1130         90         270         1300         200           1200         120         240         1330         240           1230         180         1400         240           1330         1400         240           1430         240         240           1430         240         290           1400         1530         340           1430         1600         420           1530         1600         420           1530         1700         430           1600         1730         390           1630         140         1800         440           1700         80         200         1830         450           1730         100         240         1900         470           1800         100         250         1930         430           1830         100         240         1900         470           1930         100         240         520         2100         400           2000         100         300         600         2130         400			-340					
1130         90         270         1300         200           1200         120         240         1330         240           1230         180         1400         240           1330         1400         240         240           1330         1500         290           1400         1530         340           1430         1600         420           1530         1600         420           1530         1700         430           1630         140         1800         440           1700         80         200         1830         450           1730         1800         440         1900         470           1800         100         250         1930         430           1830         100         240         1900         470           1930         100         240         2000         420           1930         100         240         2000         420           1930         100         240         2100         400           2000         100         300         600         2130         400           2000 <td></td> <td></td> <td></td> <td></td> <td></td> <td>- 00</td> <td>200</td> <td></td>						- 00	200	
1200         120         240         1330         240           1230         180         1400         240           1300         1430         240           1330         1500         290           1400         1550         340           1430         1600         420           1530         1600         420           1530         1700         430           1600         1730         390           1630         140         1800         440           1700         80         200         1830         450           1730         100         240         1900         470           1800         100         250         1930         430           1830         100         240         1900         470           1930         100         240         520         2100         400           2000         100         300         600         2130         400           2000         100         360         620         2200         400           2130         100         460         710         2330         360           2230 <td></td> <td></td> <td></td> <td></td> <td></td> <td>90</td> <td>300</td> <td></td>						90	300	
1230         180         1400         240           1330         1500         290           1400         1530         340           1430         1500         290           1400         1530         340           1500         1600         420           1530         1600         460           1530         1700         430           1630         140         1800         440           1700         80         200         1830         450           1730         100         240         1900         470         430           1830         100         250         1930         430         430         430           1900         100         200         410         2030         410         420         430         430         430         430         430         430         430         430         450         430         450         440 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		120						
1330         1500         290           1400         1530         340           1430         1600         420           1500         1630         460           1530         1700         430           1600         1730         390           1630         140         1800         440           1700         80         200         1830         450           1730         100         240         1900         470           1800         100         250         1930         430           1830         100         300         2000         420           1930         100         240         520         230         410           1930         100         240         520         230         410           1930         100         240         520         230         410           1930         100         300         600         2130         400           2000         100         360         620         2200         400           2130         100         440         680         2300         390           2230         300			180					
1400       1430       340       340         1500       1600       420       420         1530       1630       460       430         1530       1700       430       390         1630       140       1730       390         1630       140       1800       440         1700       80       200       1830       450         1730       100       240       1900       470         1800       100       250       1930       430         1830       100       300       2000       410         1930       100       240       520       2100       410         1930       100       240       520       2100       400         2000       100       300       600       2100       400         2030       100       360       620       2200       400         2130       100       360       620       230       390         2200       460       710       2330       360         2230       300       80       330       630       600         2330       300       680								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								
1500         1630         460           1530         1700         430           1600         1730         390           1630         140         1800         440           1700         80         200         1830         450           1730         100         240         1900         470           1800         100         250         1930         430           1830         100         300         2000         410           1930         100         240         520         2100         400           2000         100         300         600         2130         400           2030         100         360         620         2200         400           2130         100         440         680         2300         390           2200         460         710         2330         360           2230         300         680         2400         300           2300         80         330         630         2400         300           2330         390         620         0030         340         300           2400         380						<del></del>		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			{ <del></del>					
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			·					
1630       140         1700       80       200         1730       100       240         1800       100       250         1830       100       300         1900       100       200       410         1930       100       240       520         2000       100       240       520         2000       100       300       600         2030       100       360       620         2100       100       390       630         2130       100       440       680         2230       460       710       2330         2230       300       680       2400         2330       390       620       0030         2330       390       620       0030         2400       380       640       0100       320         6/28/82       0130       300       300		-	ł		<i>'</i>			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								- <u>-</u>
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$						<del></del>		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								
1930         100         240         520         2100         400           2000         100         300         600         2130         400           2030         100         360         620         2200         400           2100         100         390         630         2230         400           2130         100         440         680         2300         390           2200         460         710         2330         360           2230         300         680         2400         300           2300         80         330         630         6/29/82           2330         390         620         0030         340           2400         380         640         0100         320           6/28/82         0130         300         300								
2000         100         300         600         2130         400           2030         100         360         620         2200         400           2100         100         390         630         2230         400           2130         100         440         680         2300         390           2200         460         710         2330         360           2230         300         680         2400         300           2300         80         330         630         6/29/82           2330         390         620         0030         340           2400         380         640         0100         320           6/28/82         0130         300         300								
2030         100         360         620         2200         400           2100         100         390         630         2230         400           2130         100         440         680         2300         390           2200         460         710         2330         360           2230         300         680         2400         300           2300         80         330         630         6/29/82           2330         390         620         0030         340           2400         380         640         0100         320           6/28/82         0130         300         300								
2100     100     390     630     2230     400       2130     100     440     680     2300     390       2200     460     710     2330     360       2230     300     680     2400     300       2330     80     330     630     6/29/82       2330     390     620     0030     340       2400     380     640     0100     320       6/28/82     0130     300								
2130     100     440     680     2300     390       2200     460     710     2330     360       2230     300     680     2400     300       2300     80     330     630     6/29/82       2330     390     620     0030     340       2400     380     640     0100     320       6/28/82     0130     300								
2200     460     710     2330     360       2230     300     680     2400     300       2300     80     330     630     6/29/82       2330     390     620     0030     340       2400     380     640     0100     320       6/28/82     0130     300								
2230     300     680     2400     300       2300     80     330     630     6/29/82       2330     390     620     0030     340       2400     380     640     0100     320       6/28/82     0130     300		100				-		
2300     80     330     630     6/29/82       2330     390     620     0030     340       2400     380     640     0100     320       6/28/82     0130     300		<del></del>						
2330     390     620     0030     340       2400     380     640     0100     320       6/28/82     0130     300					1		300	
2400     380     640     0100     320       6/28/82     0130     300		80						
6/28/82 0130 300								
			380	640			·	
							300	
0030 360 660 0200						F '		
0100 310 680 0230			<u> </u>					
0130 260 730 0300			260					
0200 180 740 0330		180						
0230 840 0400			l					
0300 760 0430								
0330 100 840 0500			لــــــا					
0400 170 700 0530								
0430 230 660 0600								
0500 230 660 0630								
0530 230 690 0700								
0600 200 740 0730	0600	200		740	0730			

?"\_

	1	height (m)			1	neight (m)	
DATE/	z <sub>1</sub>	ı <b>Z</b> .	<sup>2</sup> 3	DATE/	<b>7</b>	7	7
TIME		<u>z</u> 2		TIME	$\frac{z_1}{z_1}$	<sup>2</sup> 2	<b>Z</b> <sub>3</sub>
6/29/82				6/30/82			
0800	<del></del>			0930			
0830				1000			
0900		l		1030			
0930		·		1100			
1000		<b></b>		1130			
1030		l <del></del>		1200			
1100		l		1230			
1130		·		1300	100		
1200		·		1330	120		
1230		ł ———		1400	170	-240	
1300				1430		240	
1330				1500		270	
1400				1530		300	
1430				1600		360	
1500		·	<del></del>	1630		340	
1530				1700		340	
1600				1730		320	
1630		ł		1800		400	
1700 1730				1830 1900		460	540
1800				1930			650
1830				2000			750
1900				2030			740
1930				2100			710
2000				2130			660
2030	<del></del>	·		2200			600
2100				2230			580
2130				2300			580
2200				2330			610
2230			· ———	2400			630
2300	<del></del>			7/1/82			
2330				0030			670
2400				0100			720
6/30/82	· ———	<del></del>		0130			730
0030			·	0200			740
0100		360		0230			770
0130		420		0300			670
0200		380	<del></del>	0330			710
0230		1 <del></del> -	<del></del>	0400		——	700
0300		<del> </del>		0430			720
0330		290		0500			770
0400		300		0530			750
0430		290		0600	<del></del>		590
0500		250		0630			530
0530		290		0700			560
0600		330		0730		400	
0630		300		0800		370	
0700		300		0830		360	
0730		300		0900		350	
0800		220		0930		340	
0830		200		1000	100	270	
0900	<del></del>	300		1030	100	280	
	· ———			استنتسا			

٦.

DATE/	7	height (m)	7 1	DATE/	7	height (m)	
TIME	$z_1$	2	<sup>z</sup> 3	TIME	_z <sub>1</sub>	2	<b>z</b> <sub>3</sub>
7/1/82							
1100	100	390					
1130	140	400					
1200	120	360					
1230	200	370					
1300	280	380					
1330	290	400					
1400	220						
1430	310	1					
	<del></del>	1					
		1					
		1					
		1					-
		11					
	<del></del>	1					
'				' - <del></del>		·	

Table 7. Boundary layer depth as determined from radiosondes

		-					
BLM-1		BLM-2		BLM-3		BLM-4	•
Date/Time 9/21-1205	$\frac{Z_i(m)}{70}$	Date/Time 1/5 -1953	$\frac{Z_{i}(m)}{230}$	Date/Time 12/6-1615	Z <sub>i</sub> (m) 340	Date/Time 6/21-1100	Z <sub>i</sub> (m) 890
22-0015	360	6 -0740	110	7-0450	150	1535	840
1215	800	1905	60	1645	130	22-0000	810
23-0715	370	7 -0800	5	8 <b>-</b> 0450	5	0900	720
1250	340	1850	270	1445	5	1500	880
24-0010	220	8 -0815	570	1825	130	2345	750
1215	310	1915	410	9-0435	230	23-0900	600
25-0040	230	9 -0810	80	1635	980	1500	600
27-0607	400	1800	100	10-0435	5	24-0000	260
1820	400	13-1930	140	1640	1270	0900	470
28-0740	280	14-0705	40	11-0500	600	1500	550
1705	260	1920	230	1445	630	25-0000	790
29-0630	150	15-0830	150	1851	920	0900	420
1735	30	0900	30	13-0507	150	1500	600
30–1207	70	1905	220	1455	50	27-0000	480
10/1-0025	,0 5	16-0820	400	1620	5	1145	120
1230	110	1935	280	14-2030	60	1500	90
2200	5	1933	280	15-1253	60	28-0000	410
2-1040	20			2007	1110	0900	750
2-1040	20			16-1610	5	1500	860
				10-1010	3	29-0000	1020
						0900	100
						1500	150
						30-0000	1380
						0900	600
						1500	850
						7/1-0900	680
						1500	600
						100	~~

## IV-3. Radiosonde Profiles and Mixed Layer Parameters

During BLM-1,2 and 3, radiosondes were released from the ship twice a day, generally near 0700 and 1900, local time. During BLM-4 three daily releases were made, at 0900, 1500, and 2400, local time. This operation was performed by Navy radiosonde teams from the Naval Oceanography Command Facility, North Island, San Diego, CA. Upon completion of the launch and initial evaluation of a sounding, the team immediately reported the inversion height to the meteorology team watch so it could be logged into the data acquisition system. The radiosonde determined inversion height was used when available because of difficulties in interpreting the acoustic sounder, which were described in the previous section.

The common procedure of determining temperature and humidity at standard levels and significant points is too coarse for our purposes. We are interested in the detailed structure of the boundary layer. Thus, the original strip chart output and the radiosonde calibrations are used to obtain finer scale data. These data are then entered into a computer and the virtual potential temperature,  $\theta_{\mathbf{v}}$ , and water vapor mixing ratio, q, profiles calculated and plotted. These plots are digitized to produce the well mixed values of  $\theta_{\mathbf{v}}$  and q in the boundary layer, their jumps at the layer top (assuming no gradient or a 1st order jump) and the gradients above. The digitized results are then plotted as dashed line profiles and the determined quantities printed on the same graph.

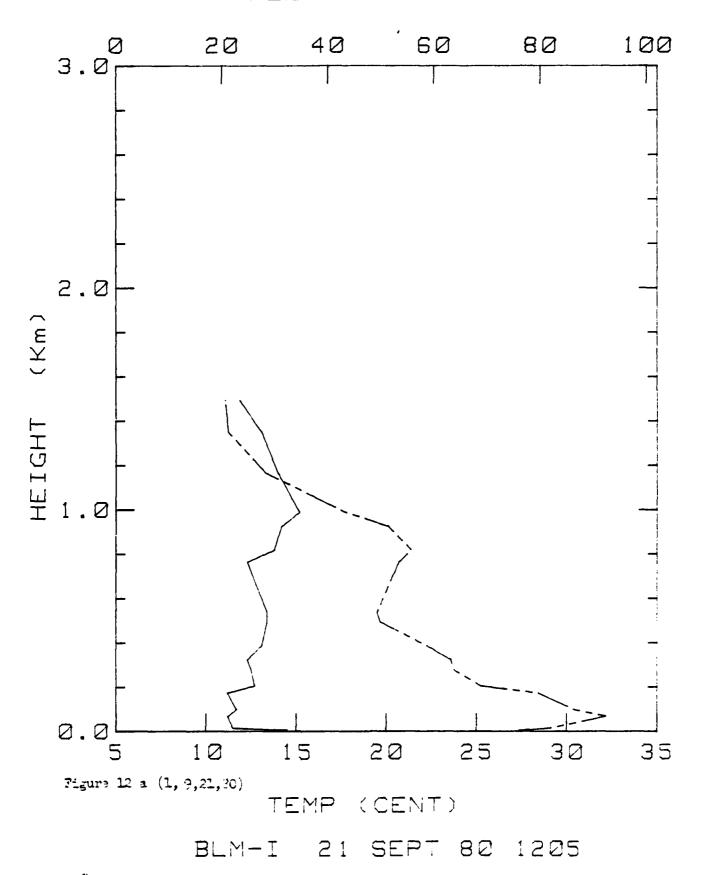
This procedure allows one to obtain as good a determination of boundary layer properties as is possible from these types of data. The well mixed values, jumps, and gradients above are the

parameters that are needed as inputs to an integrated boundary layer model. 17 Examination of the graphs also allows one to determine quickly whether the layer is well mixed or not.

There are two apparent sources of error in radiosonde results. The data from the lowest height, which is obtained at the ship, and the first reading after release, where the sonde has not come to equilibrium, are often in error and should not be used. Thus, it is not possible to use the radiosonde to determine surface layer properties. Also, the humidity sensor is not capable of determining a value below 20% so that errors can be introduced in the dry region above the marine layer.

The fine scale radiosonde profiles and the and q digitized profiles are presented in Figures 12. The two types of plots for a given day are on facing pages for easy comparison. On the temperature/humidity plots the solid line is temperature and the dashed line humidity. On the potentential temperatue/specific humidity plots the curve on the right is potential temperature, and the units in the enclosed table are gm/kgm and °C.

## REL HUMIDITY (%)



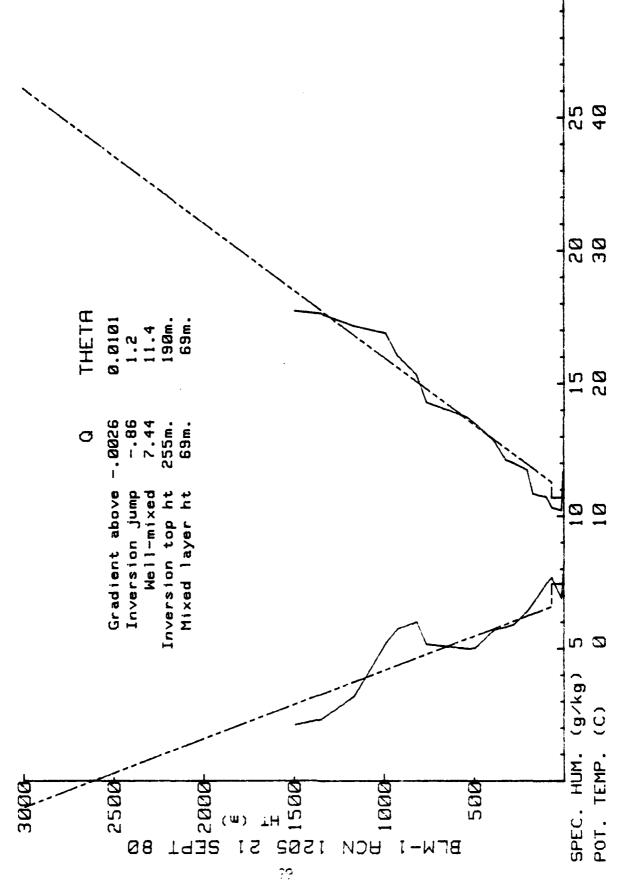
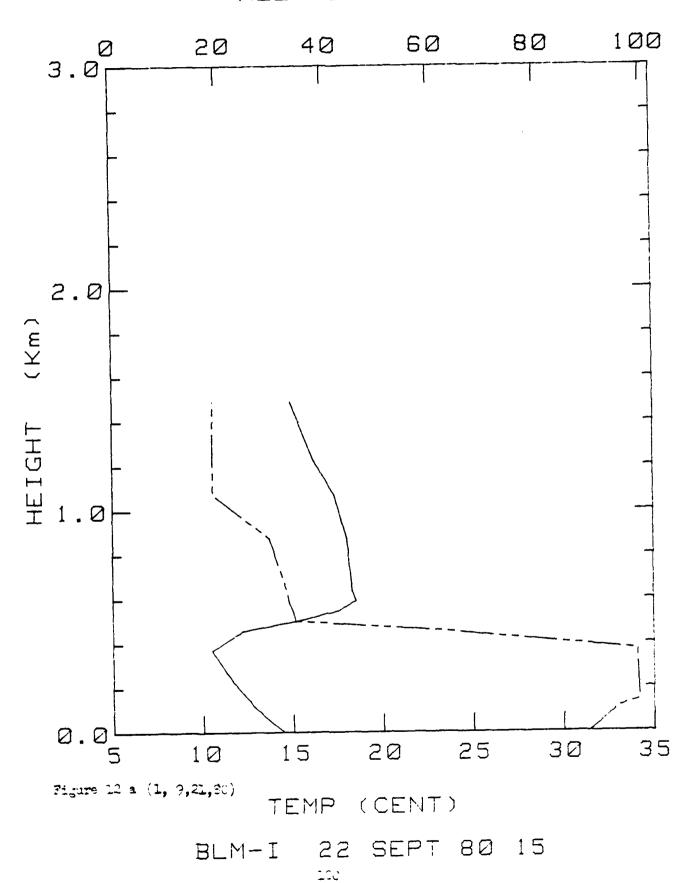


Figure 1 : 1 (1, 9, 1, 3)



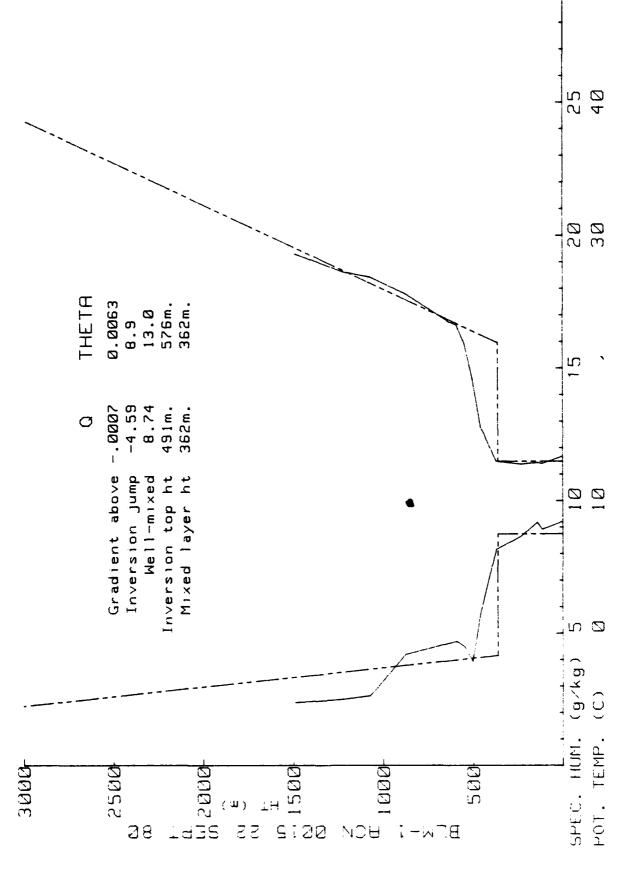
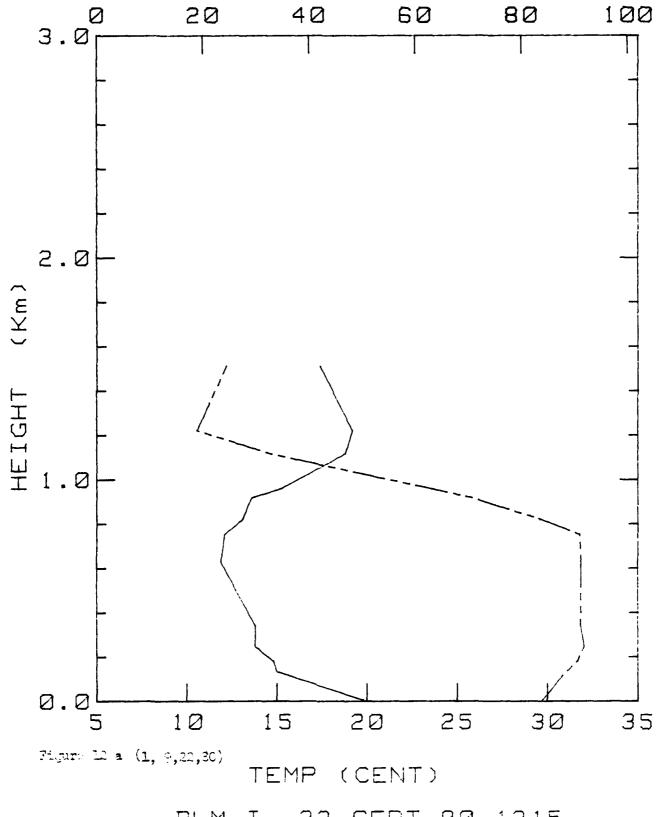
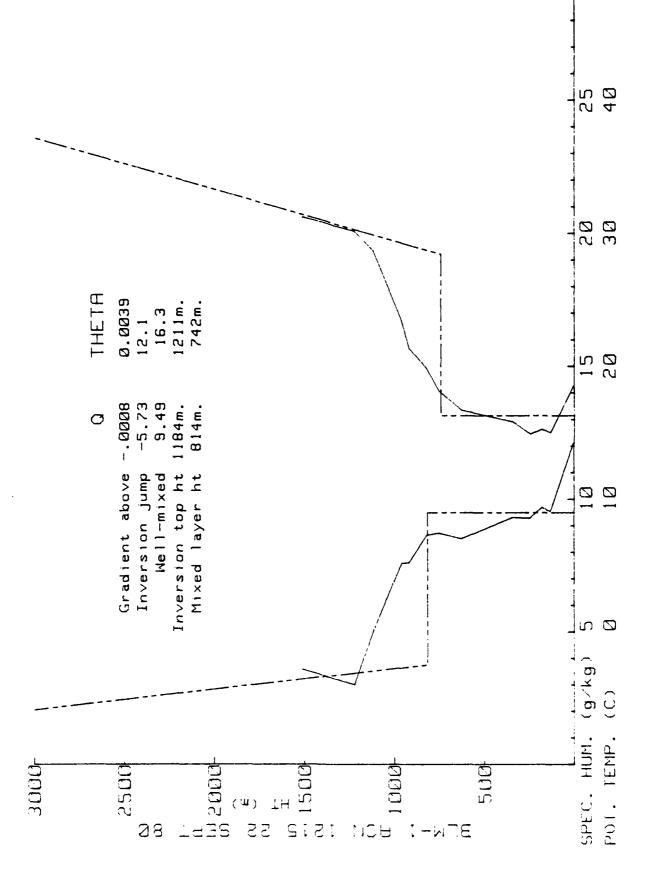


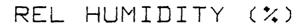
Figure 12 b (1, 9,22,80)

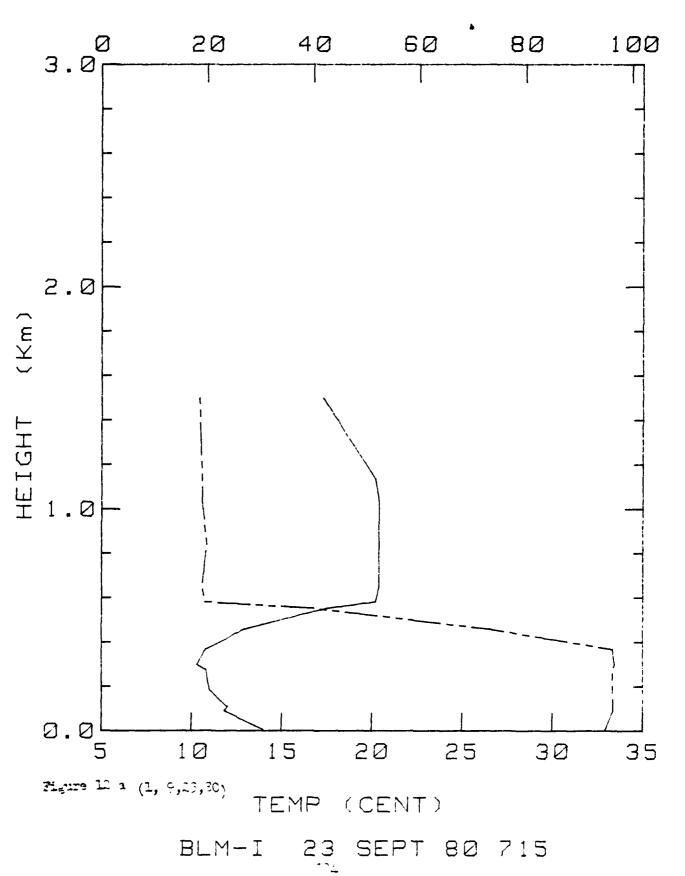


BLM-I 22 SEPT 80 1215



Fi. care 12 b (1, 9,22,30)





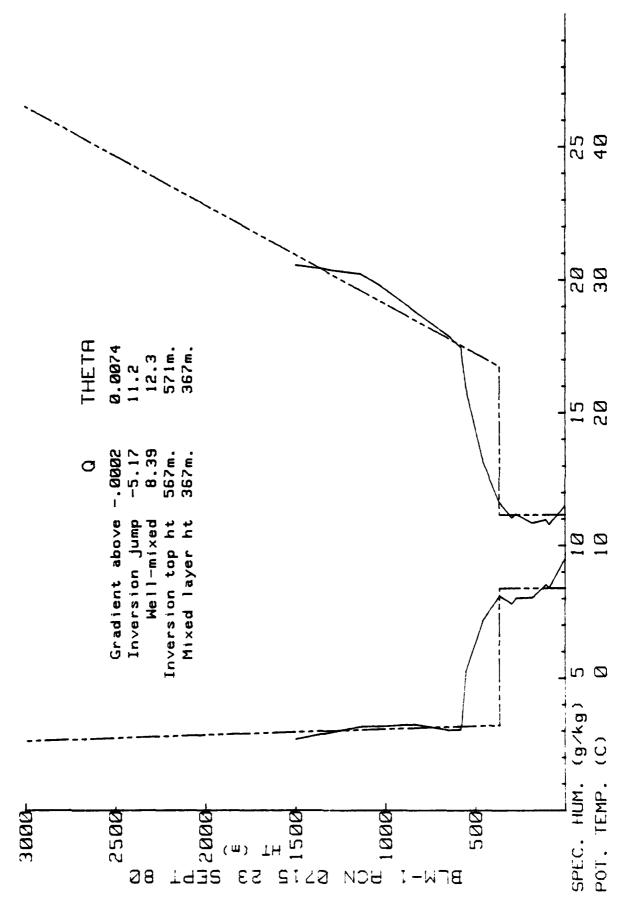
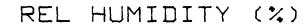
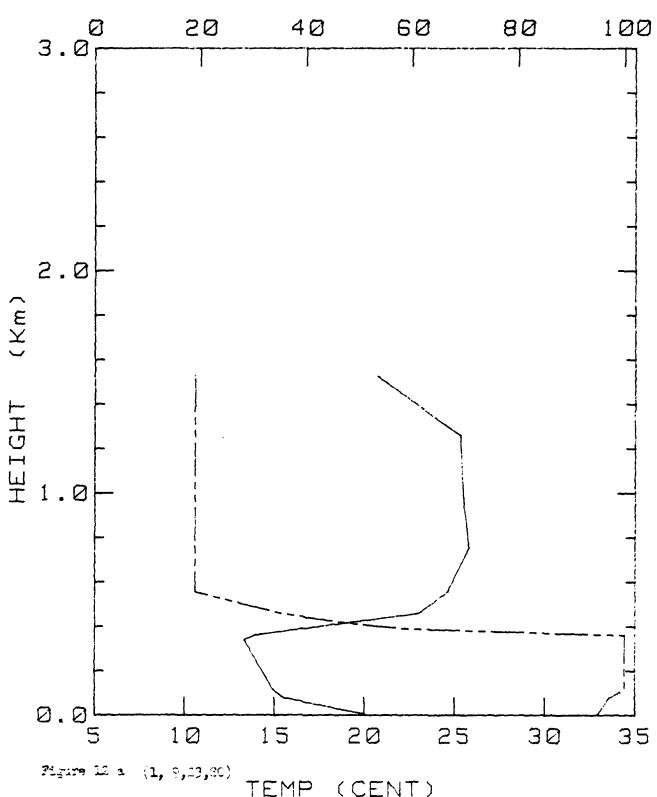


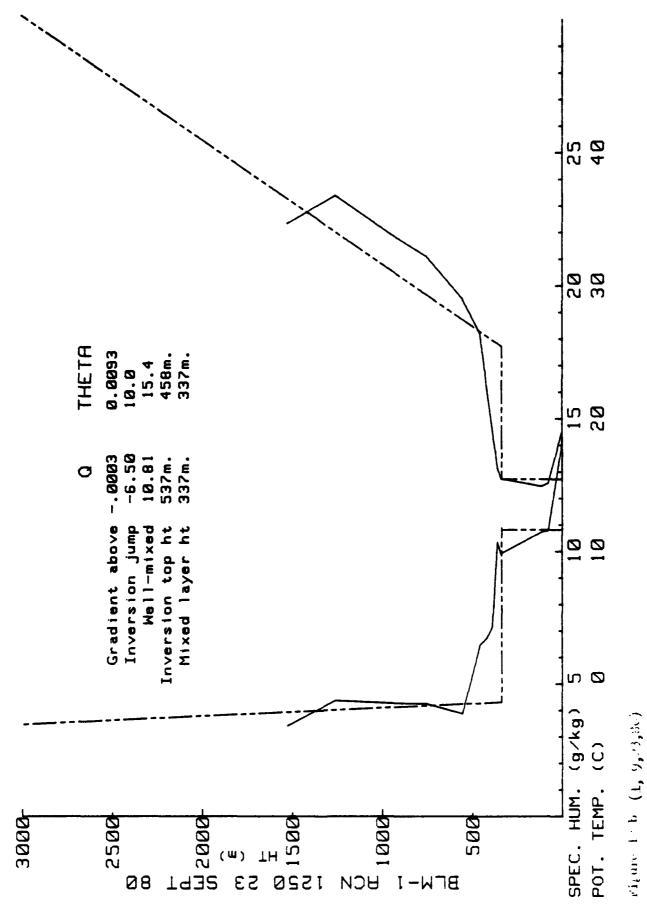
Figure La b (1, 9,23,80)

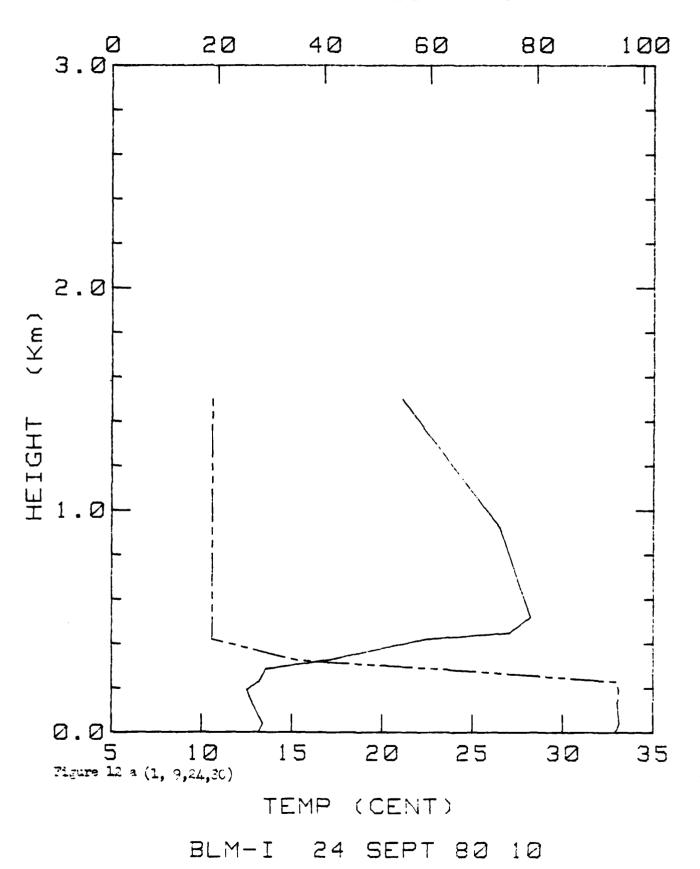




TEMP (CENT)

BLM-I 23 SEPT 80 1250





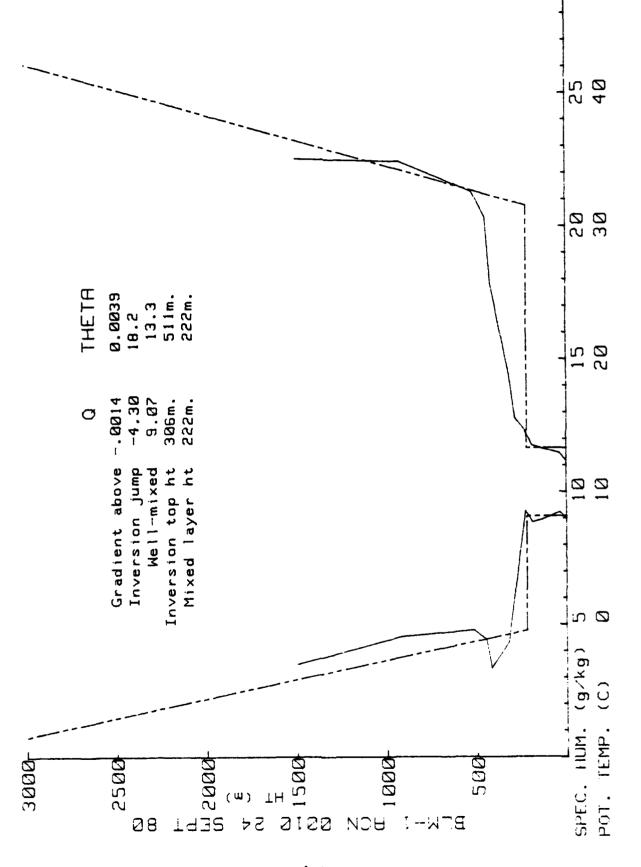
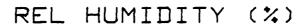


Figure 1: b (1, 9,24,30)



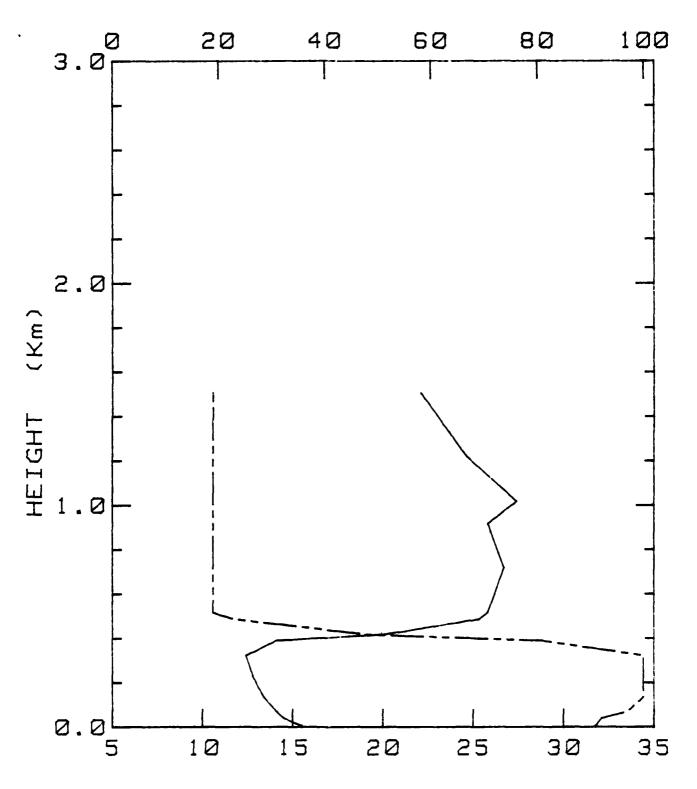
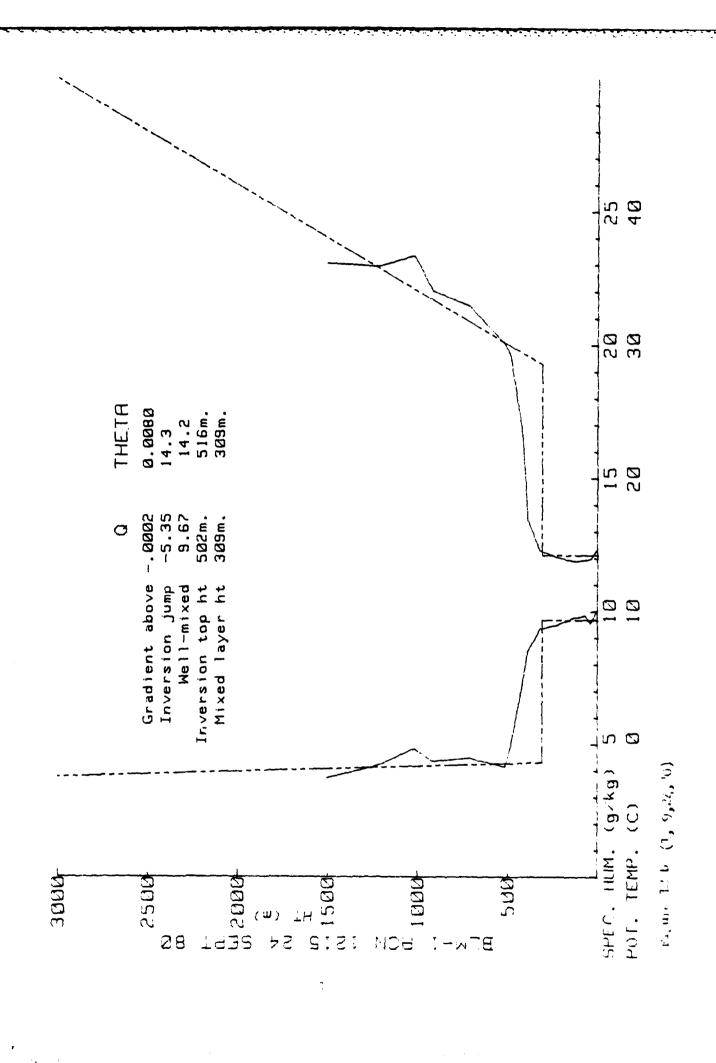
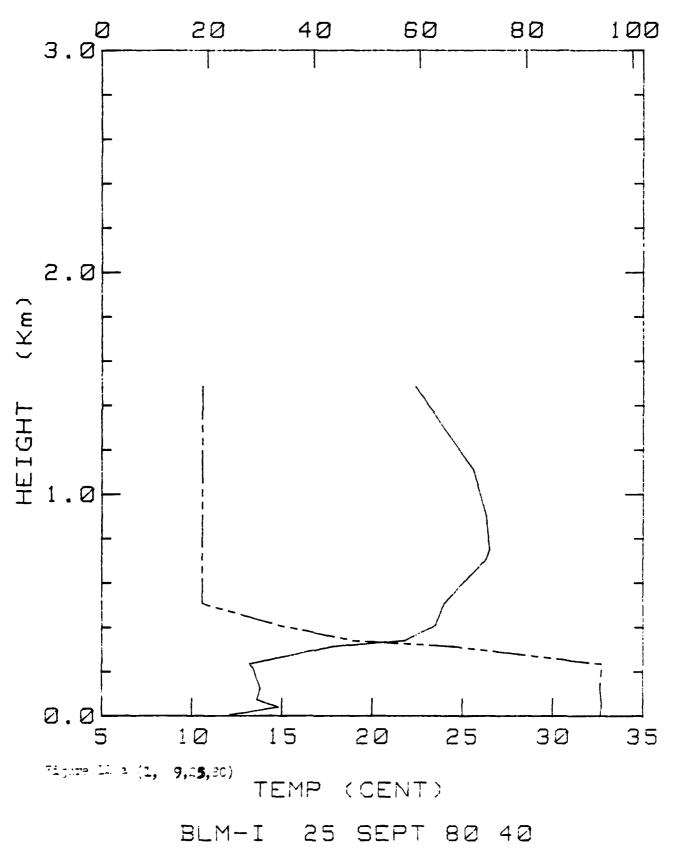


Figure 10 a (1, 9,21,50) TEMP (CENT)

BLM-I 24 SEPT 80 1215





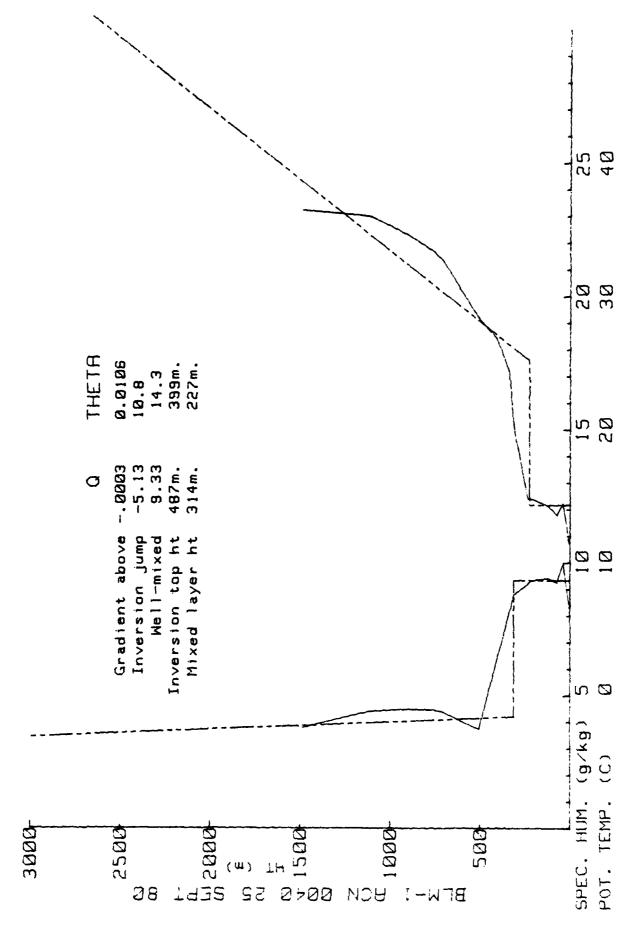
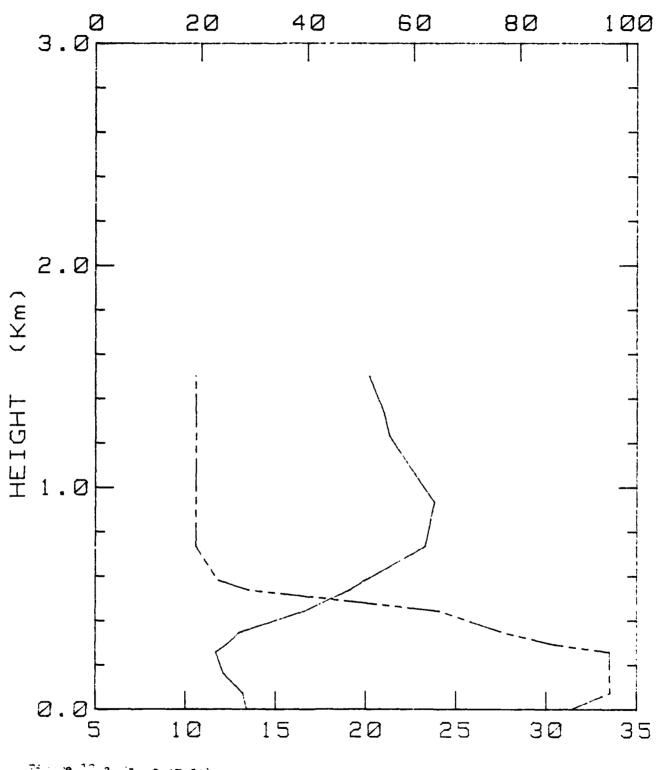
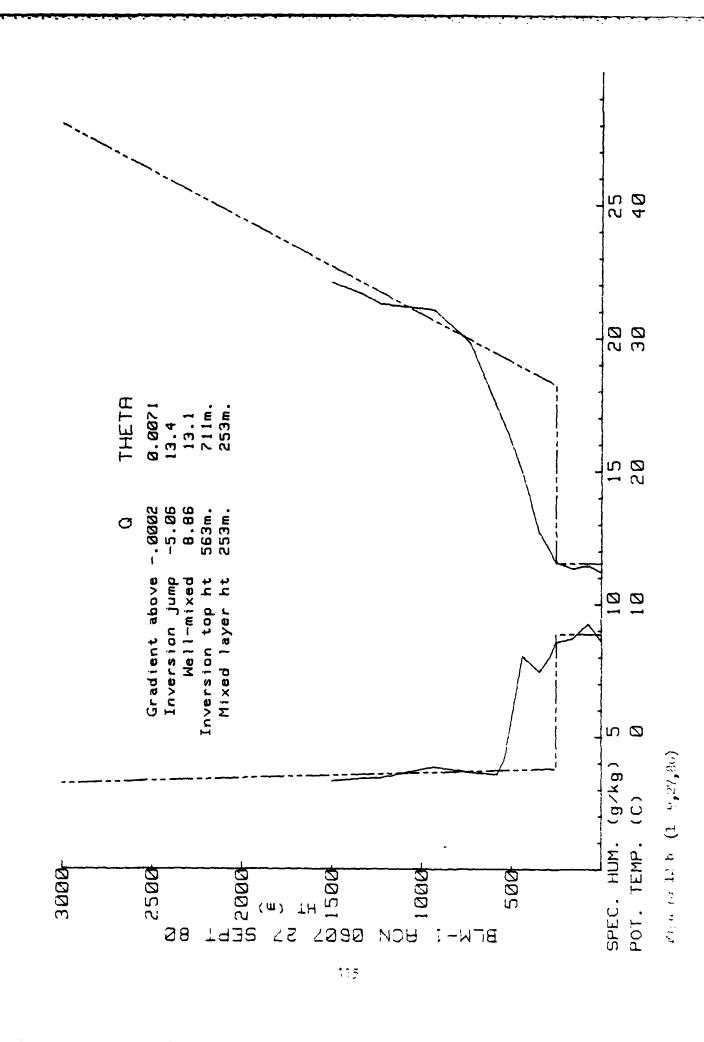
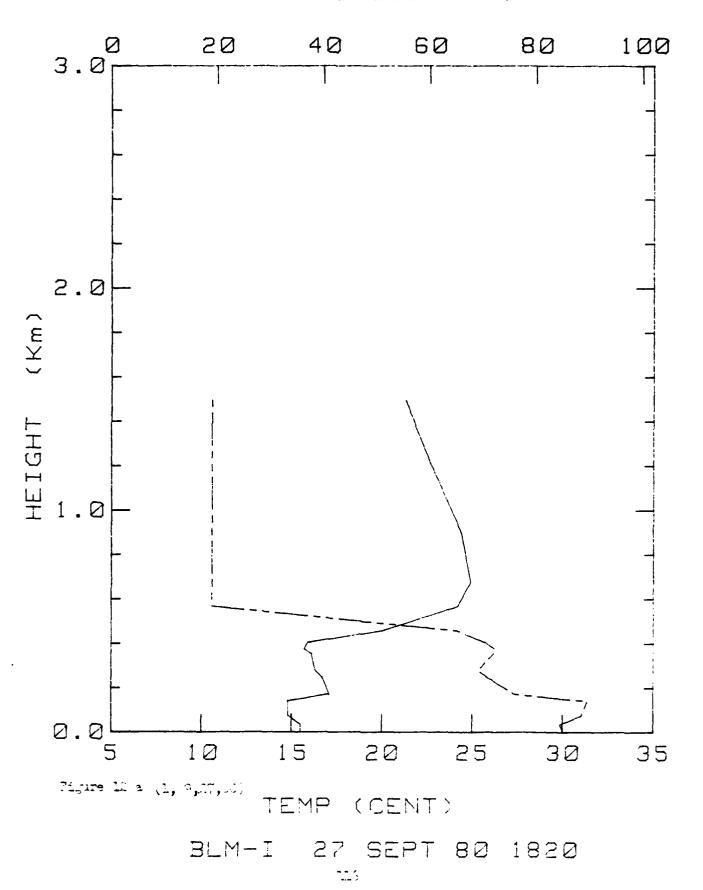
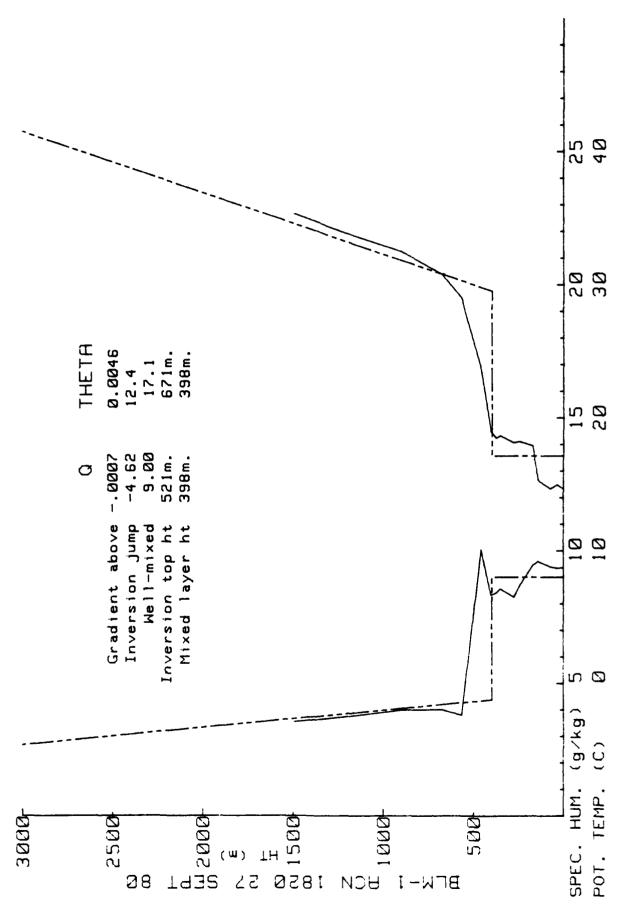


Figure 1. b (1, 5,25,30)

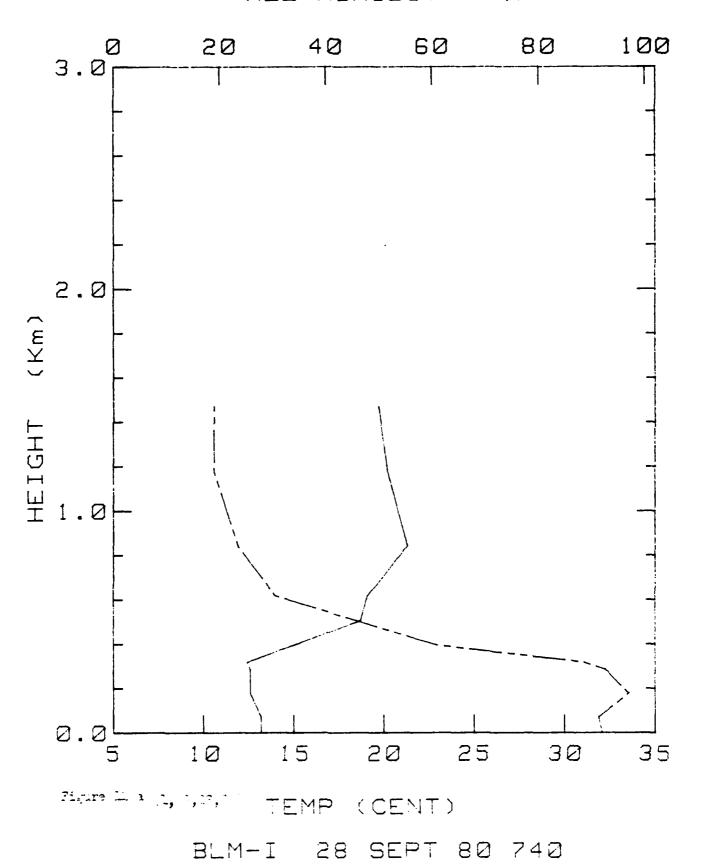


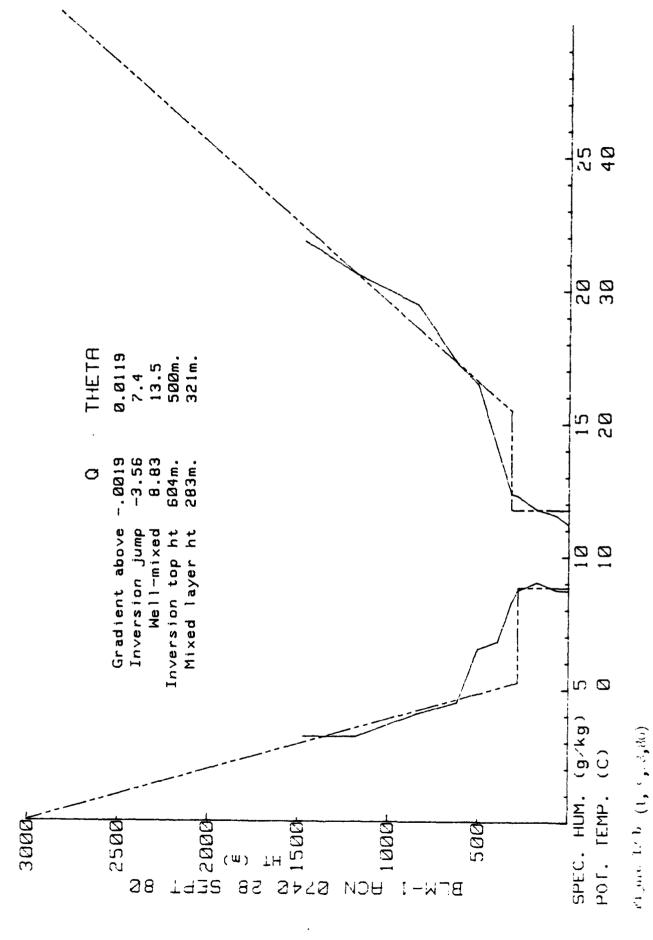






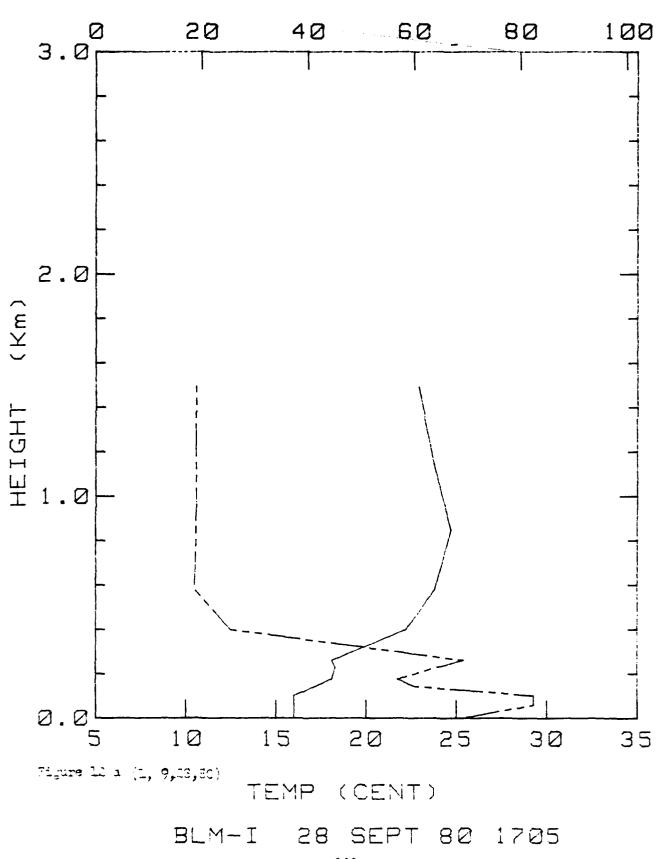
Moure 1 10 (1, 9,00,80)

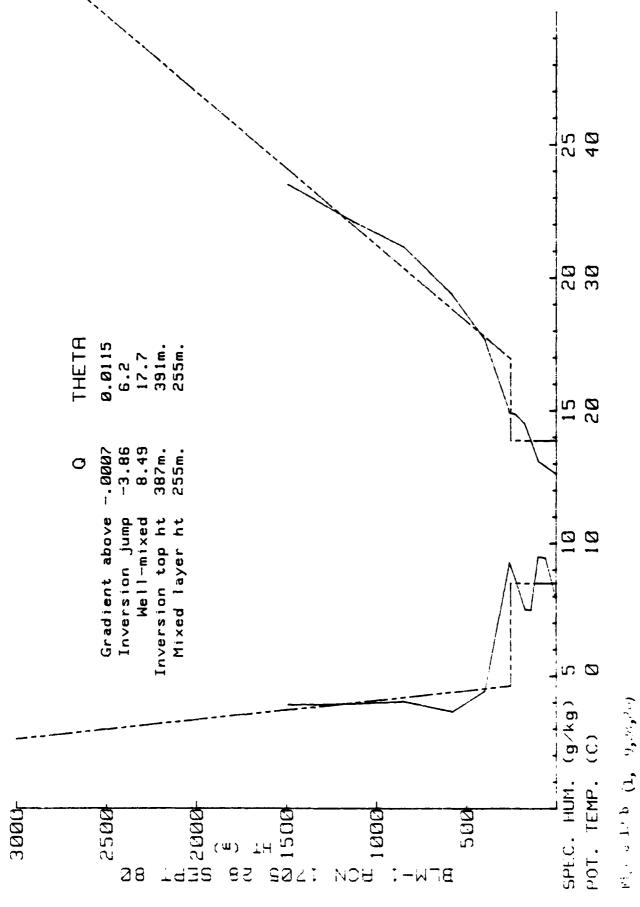


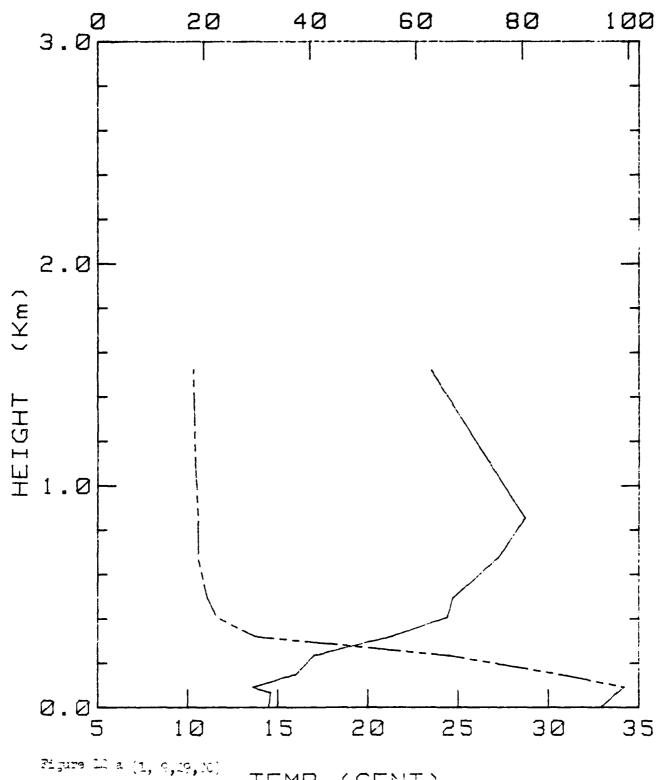


110

I will be a second to the seco







TEMP (CENT)

BLM-I 29 SEPT 80 630

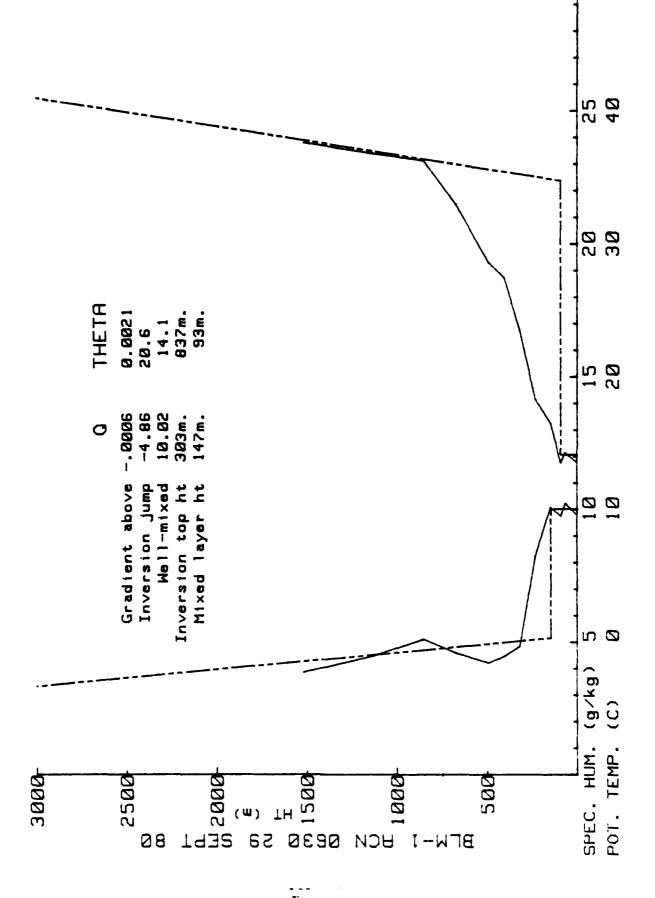
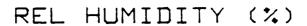
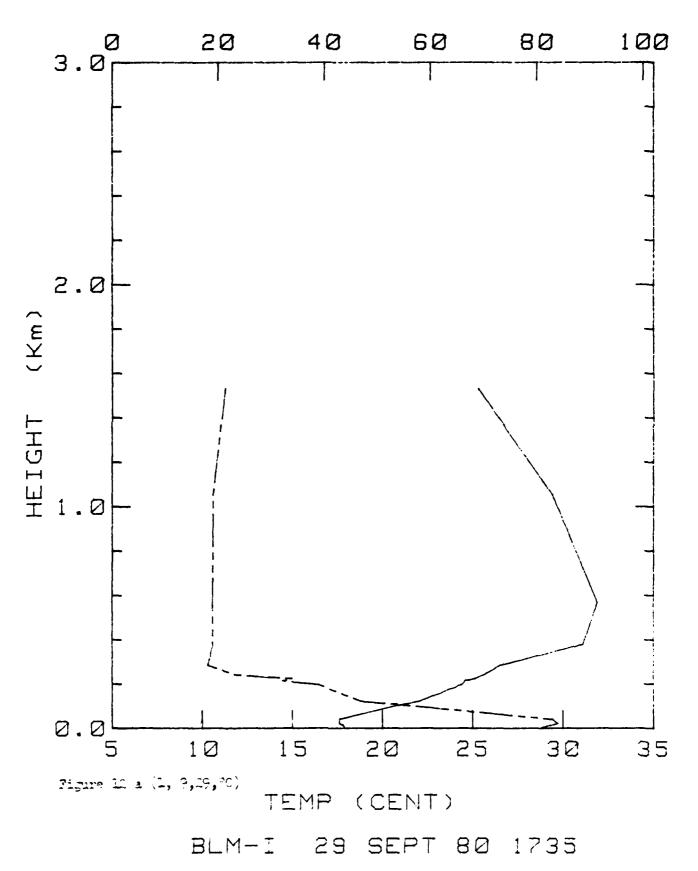
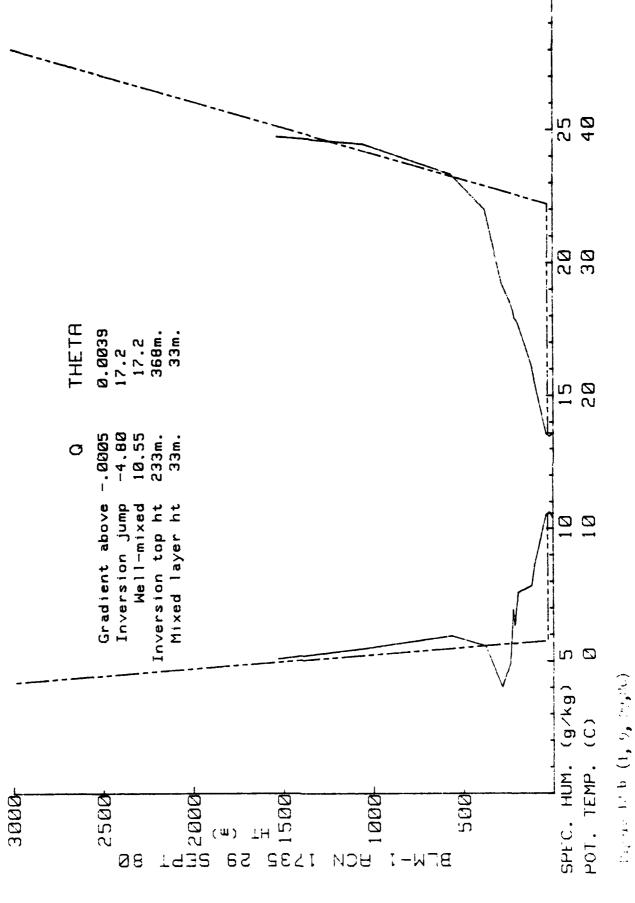


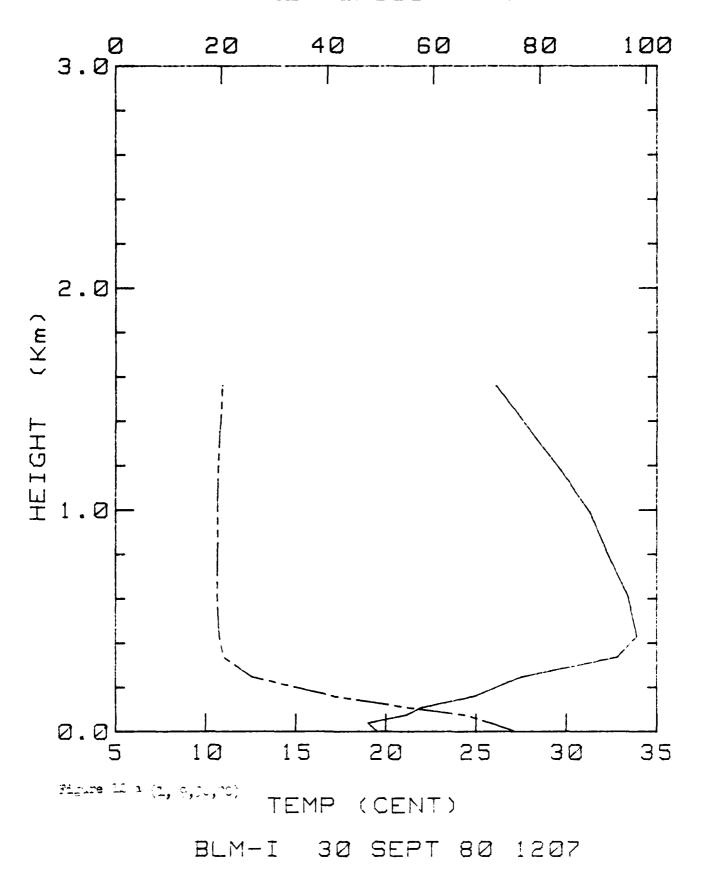
Figure 12 b (1, 5,39,30)

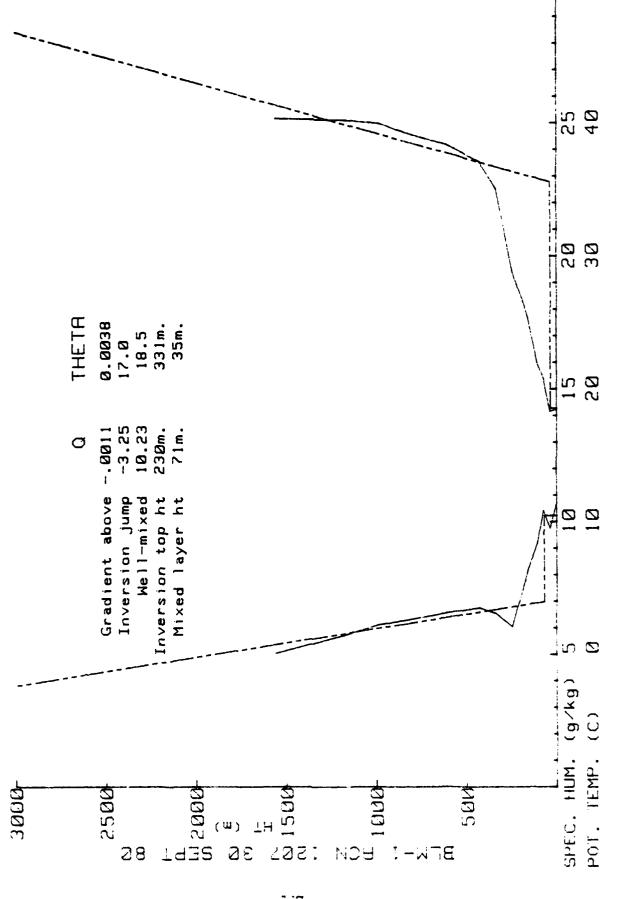






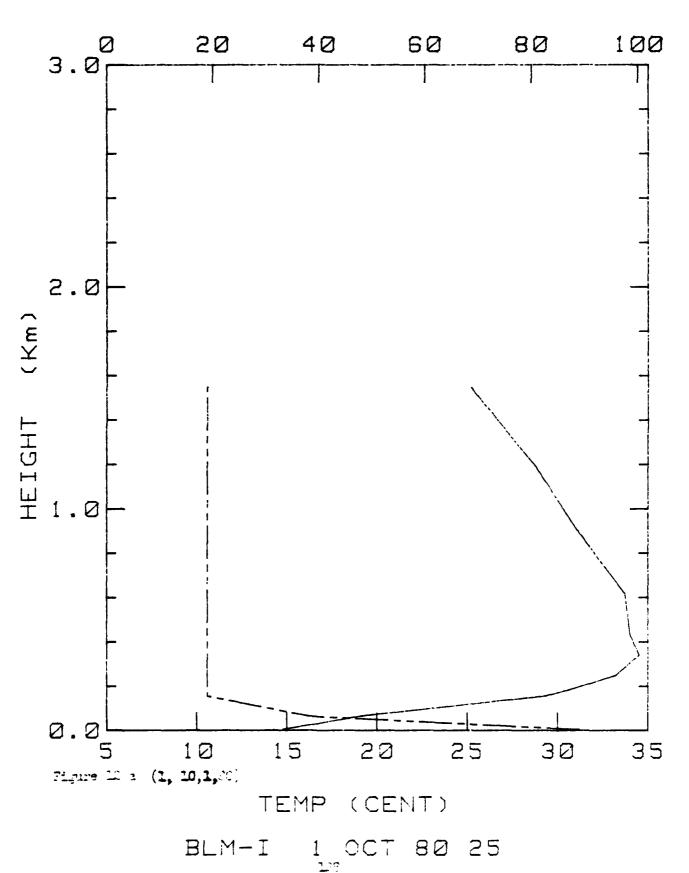
1:5

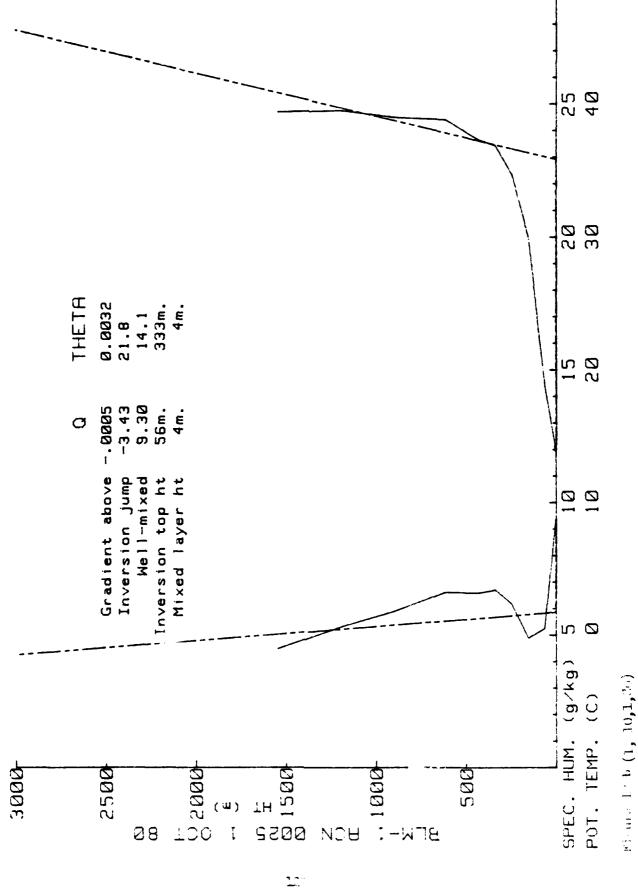




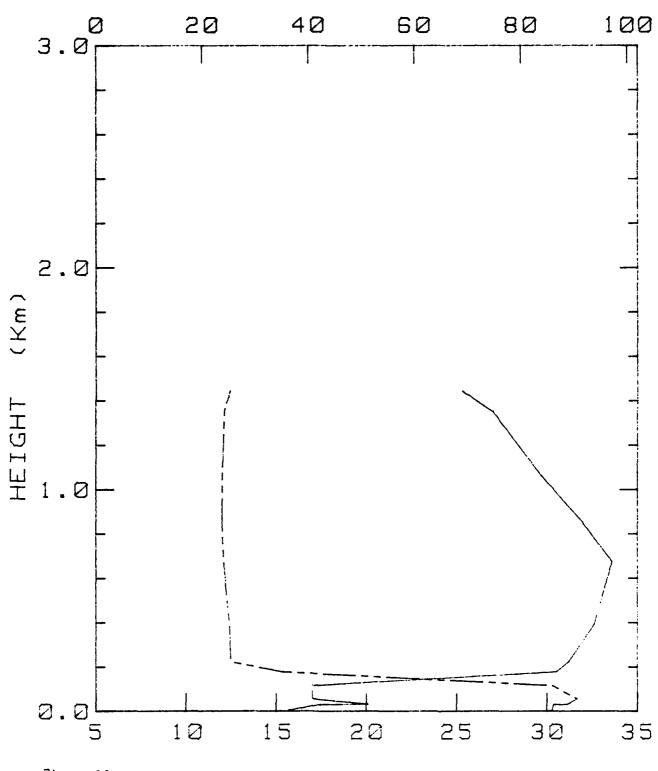
.1.7

Fig. 12 b (1, 9, 30, 30)

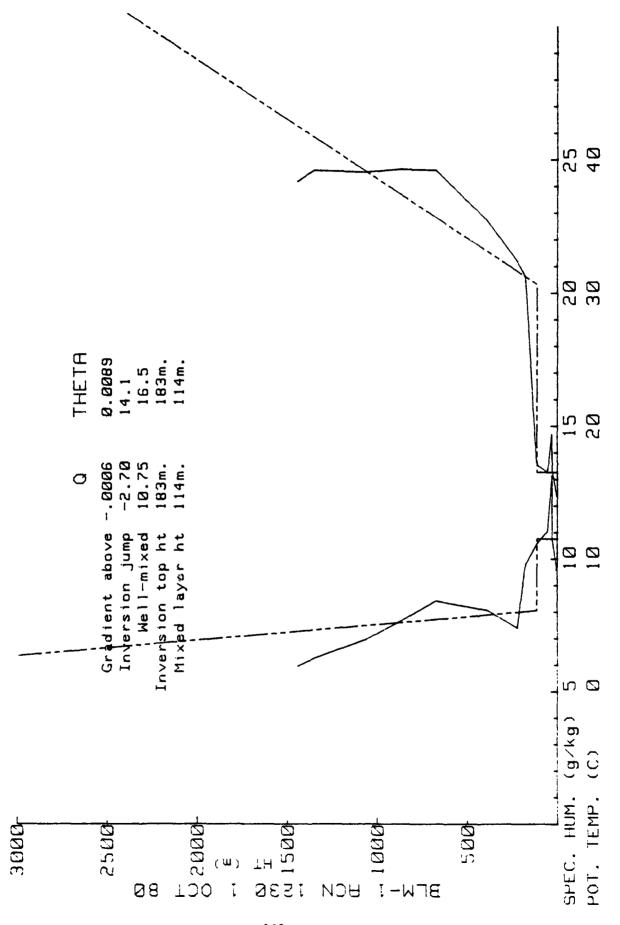




C

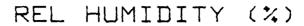


BLM-I 1 OCT 80 1230



T

Figure ! b (1, 1, 1, 1, 1, 1, 1)



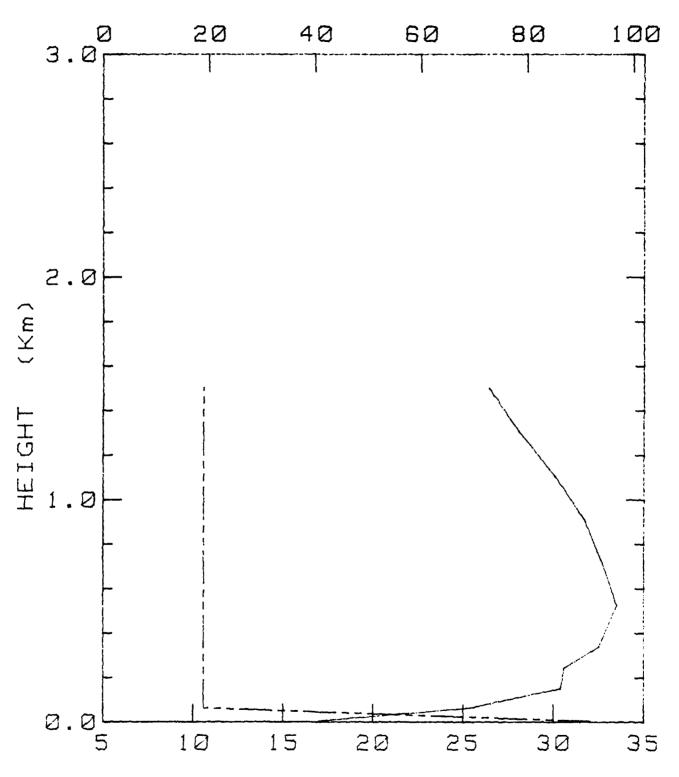


Figure II & Taylor, III TEMP (CENT)

BLM-I 1 OCT 80 2200

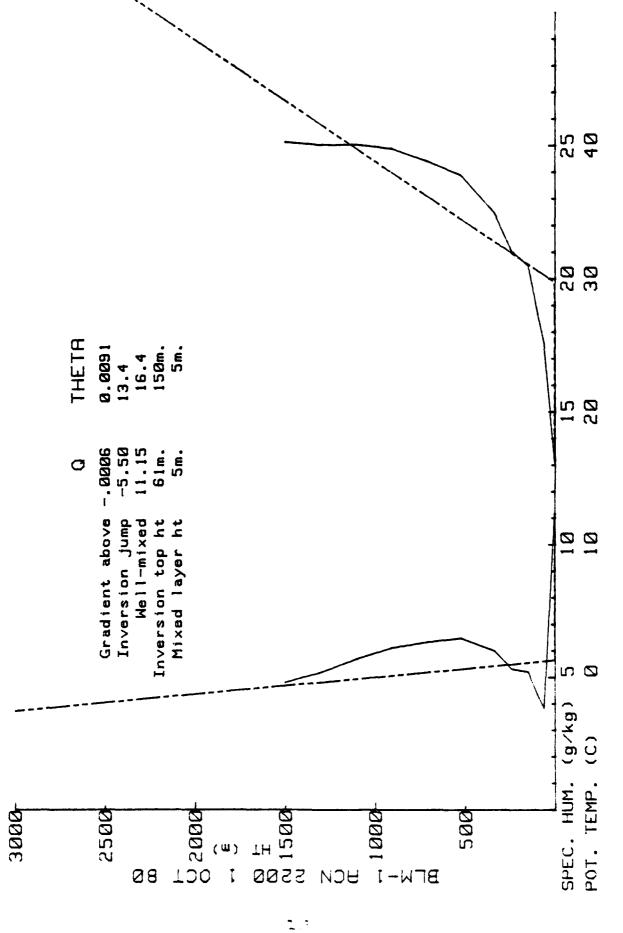
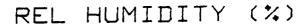
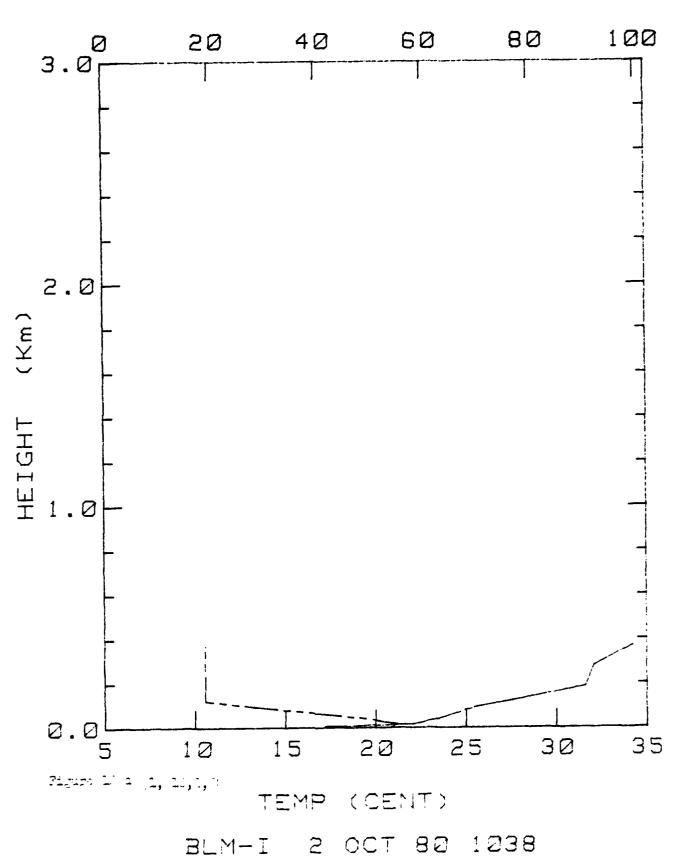
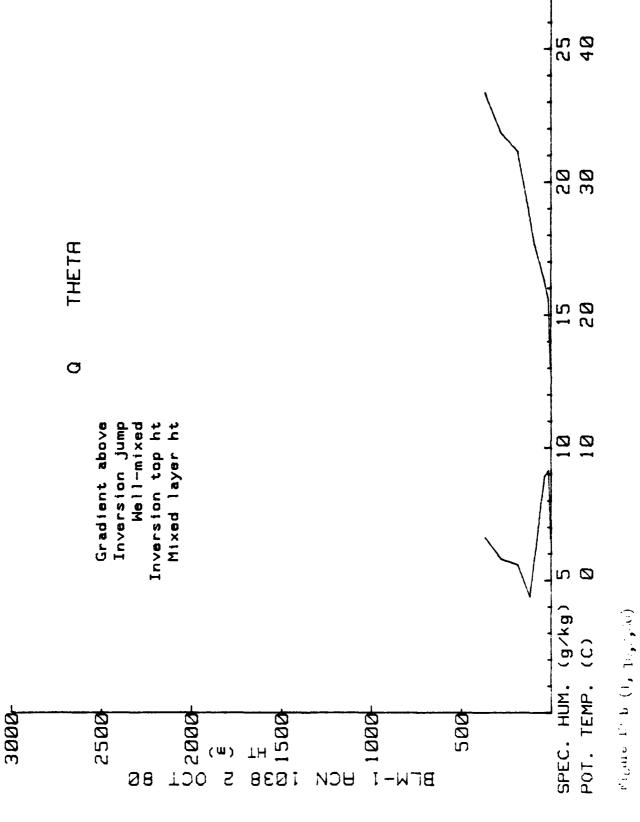
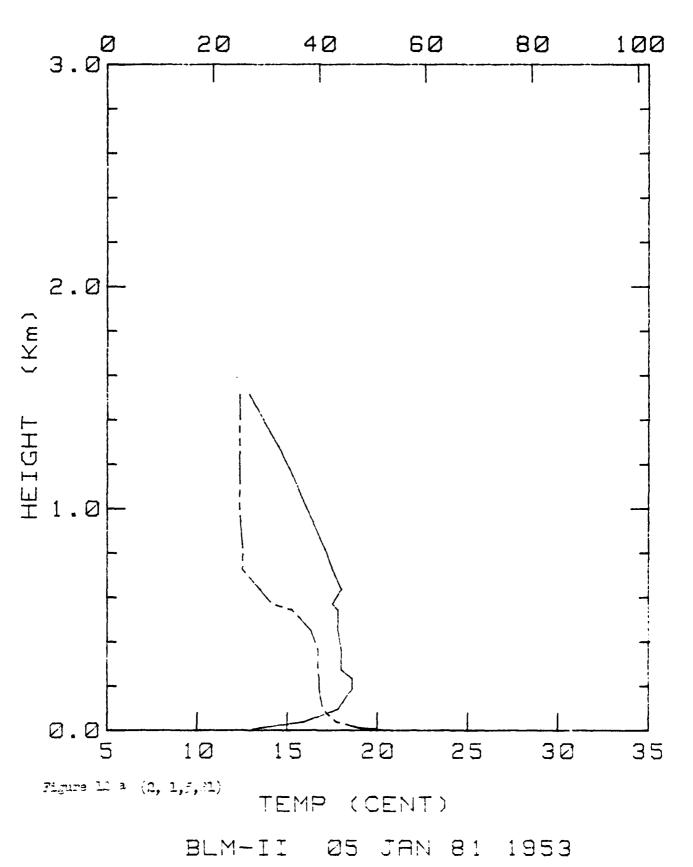


Figure Lit (1, 10, 1, 50)









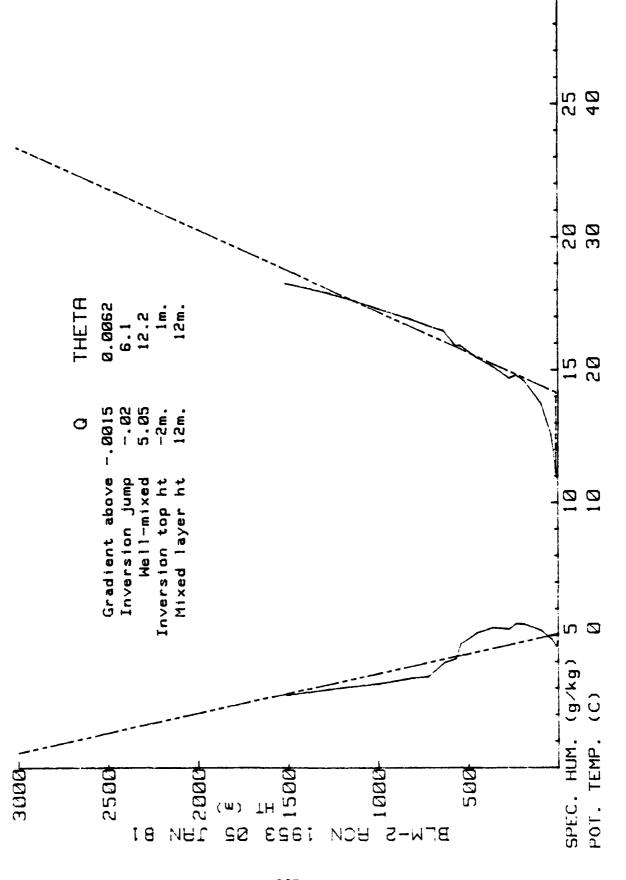
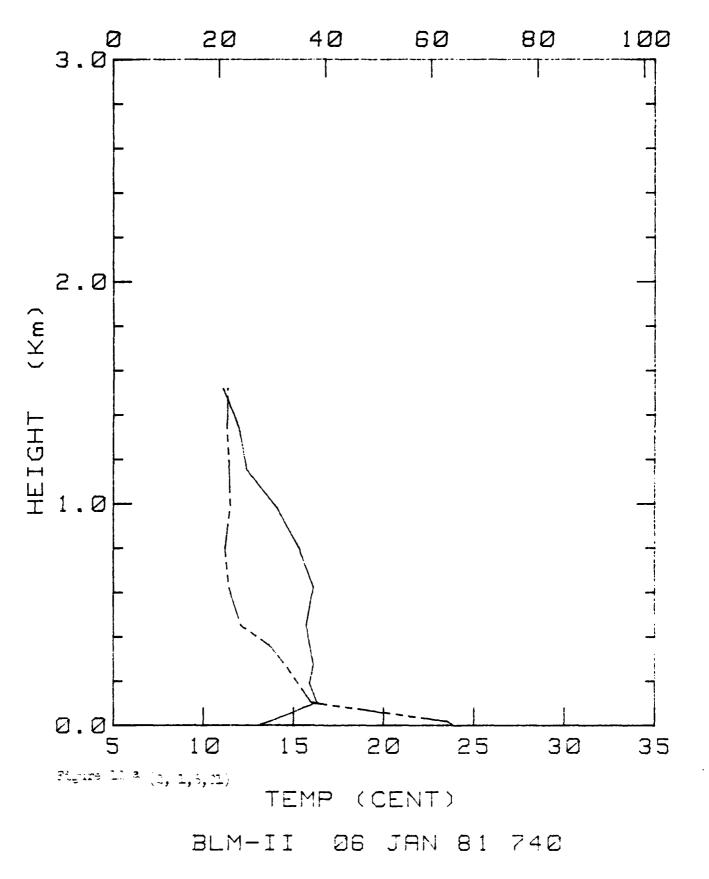


Figure 1 h (2, 1, 5,31)



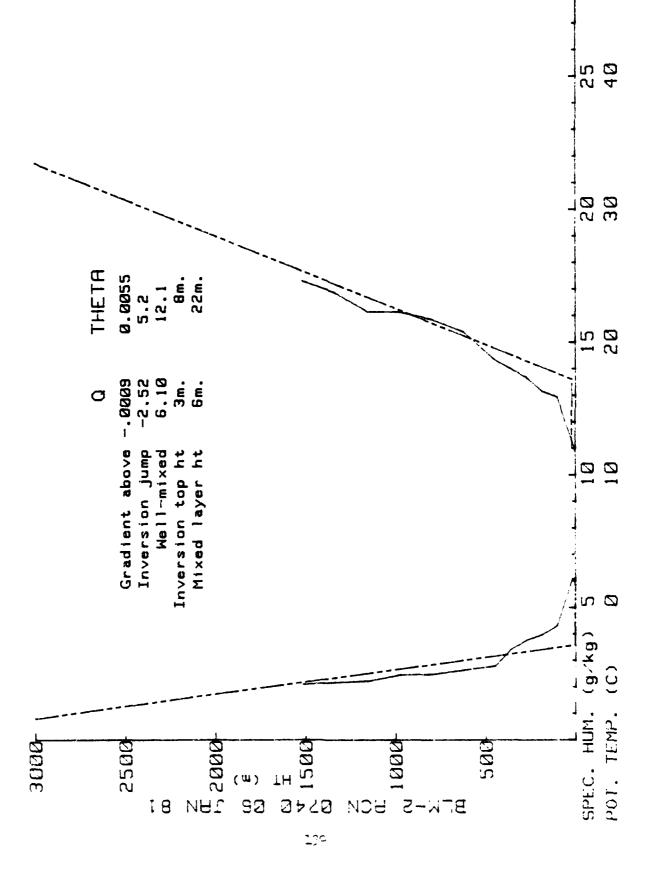
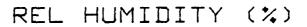
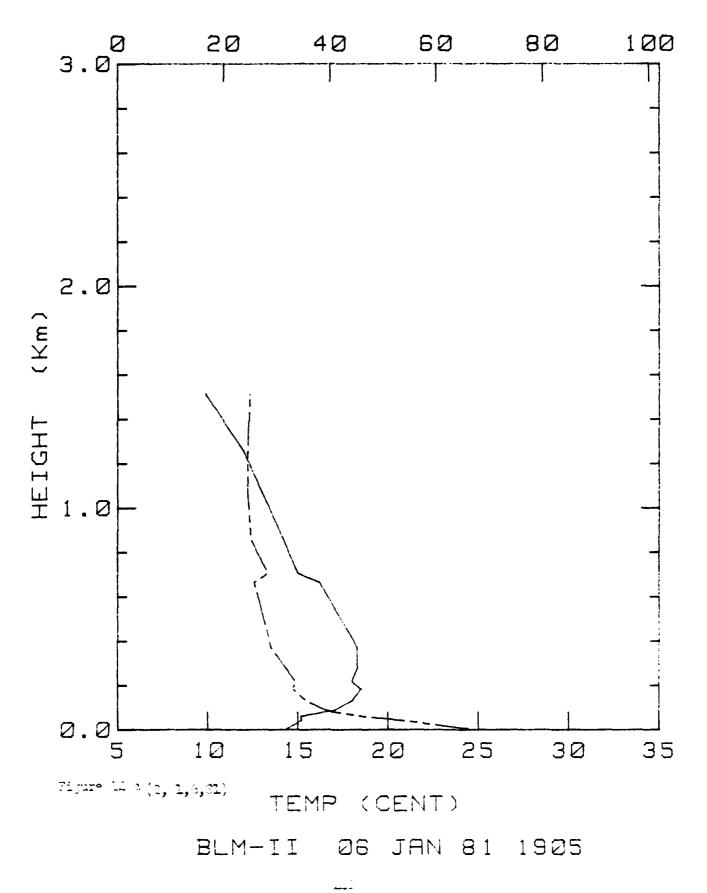
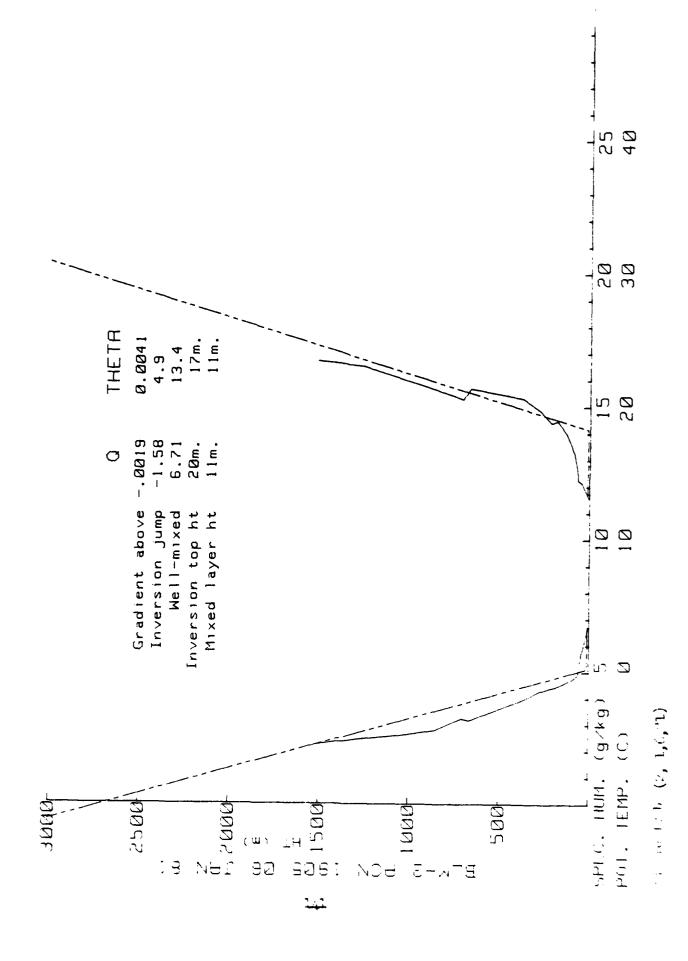
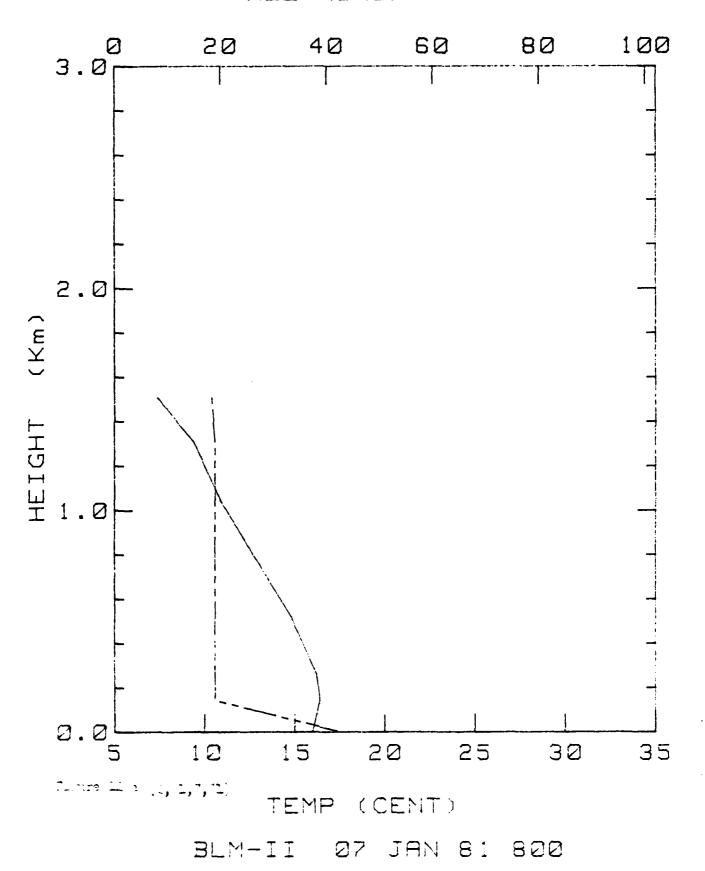


Fig. 1. b (2, 1,7, 1)



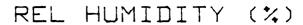


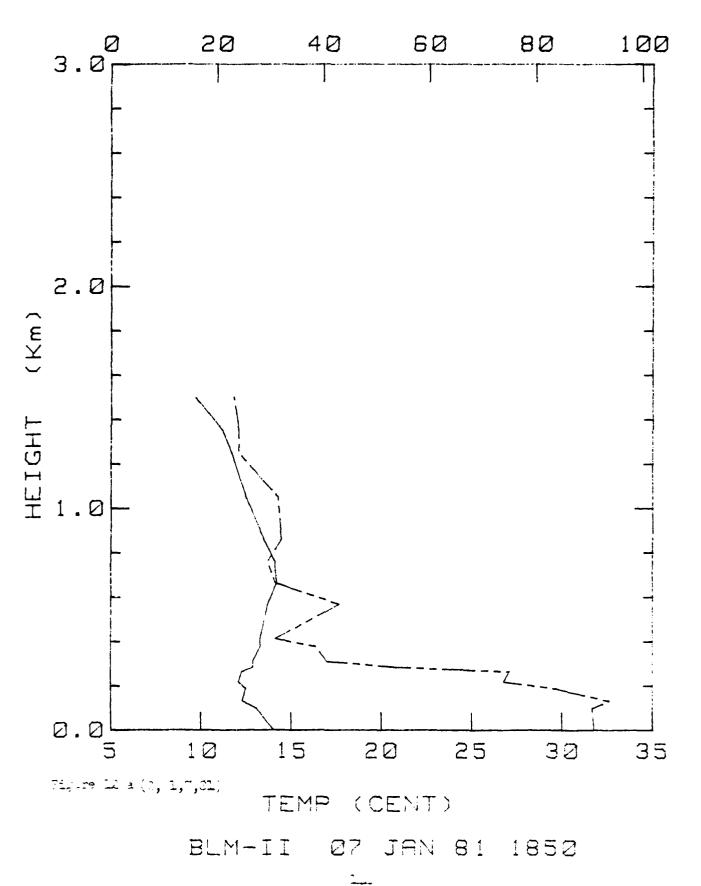


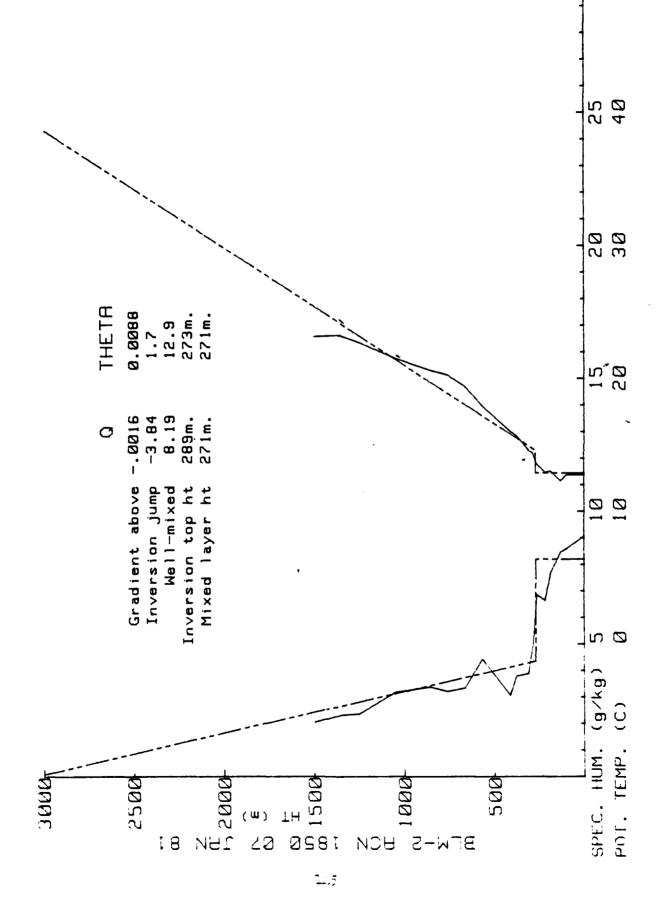


• •

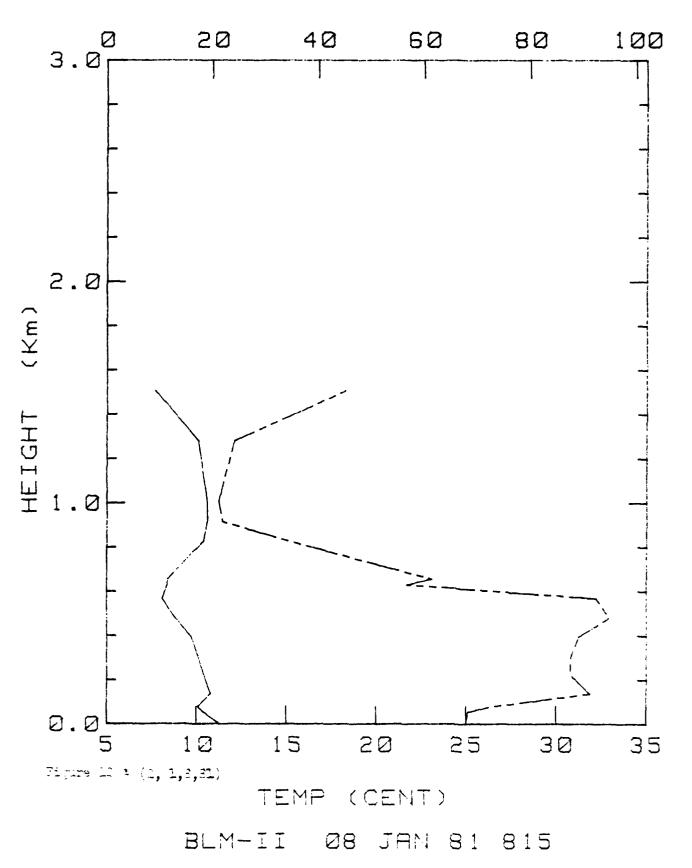
ALC: 10 10 (1, 1,7,31)

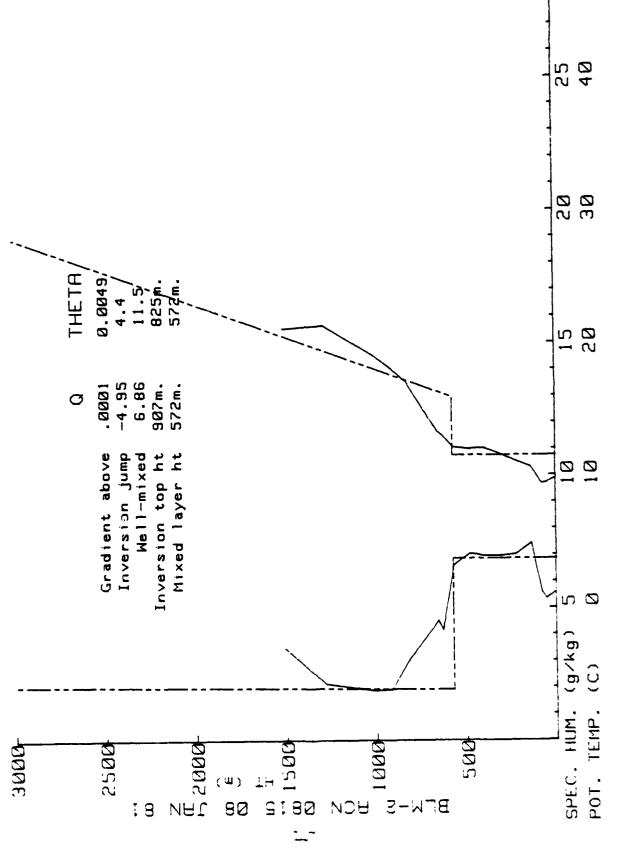






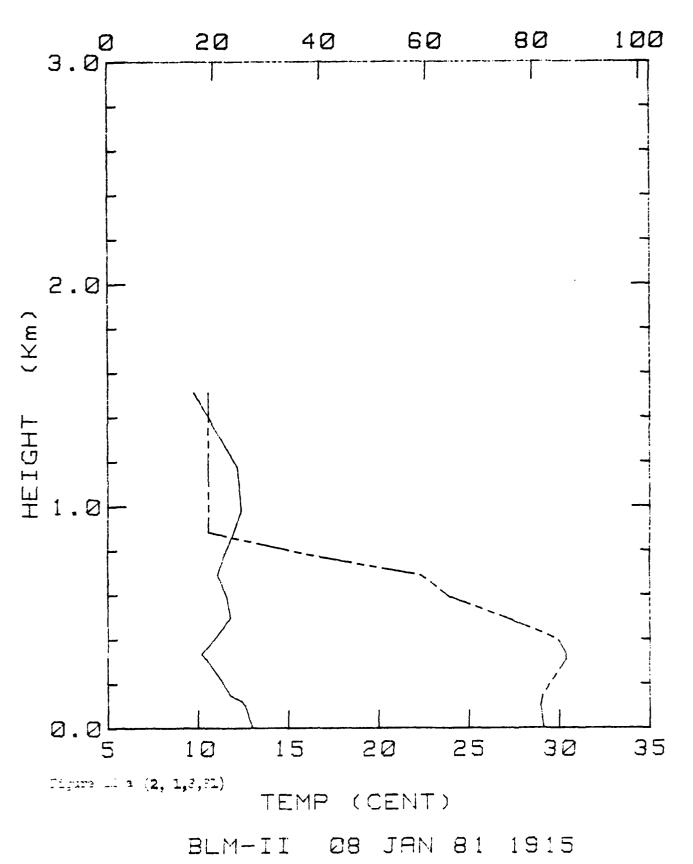
15 5 1 1 (2) 1,7,81)





7

41, at a b (2, 1,8,81)



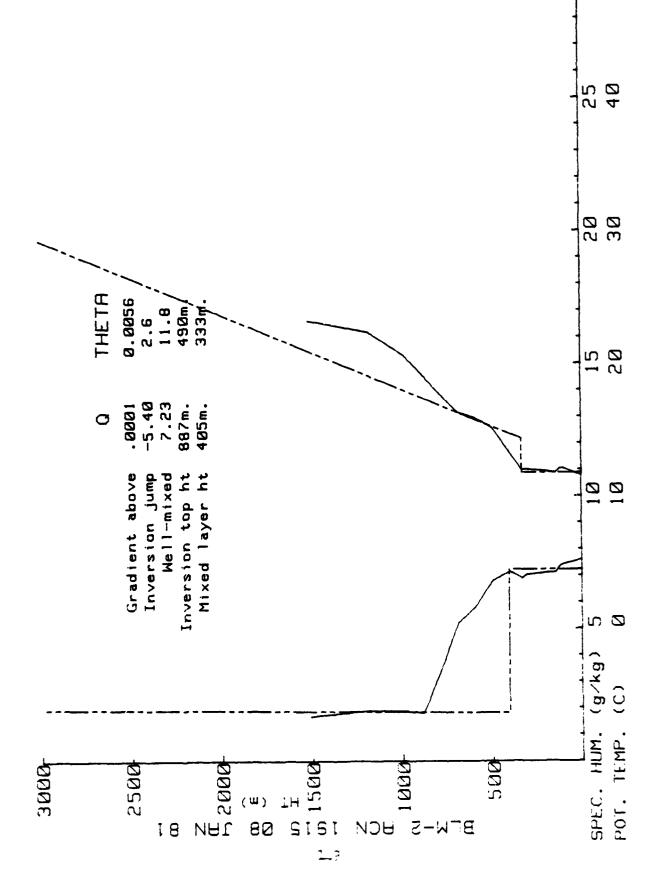
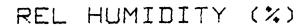
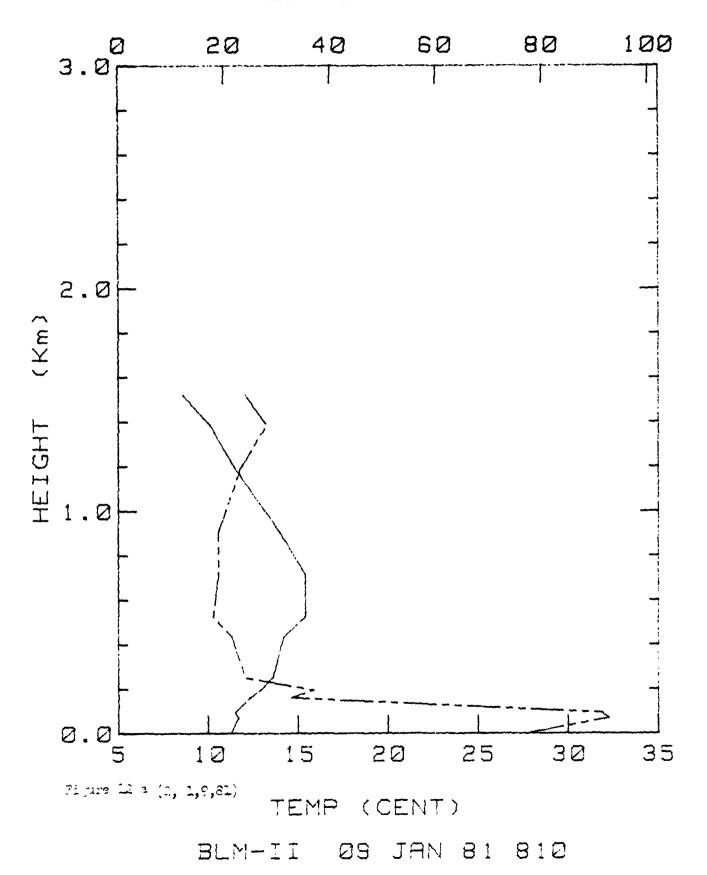


Figure 1' b (2, 1,8,81)





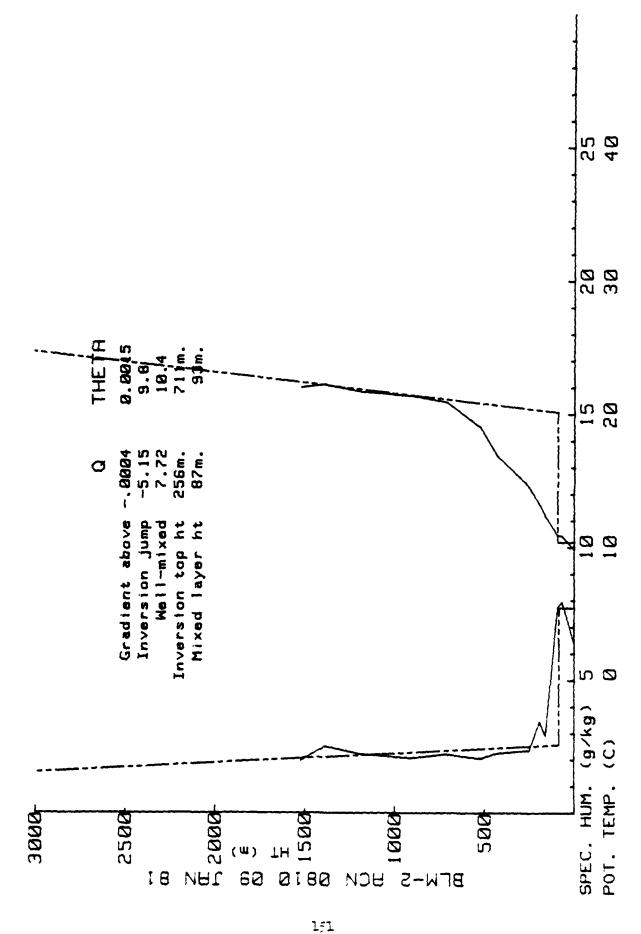
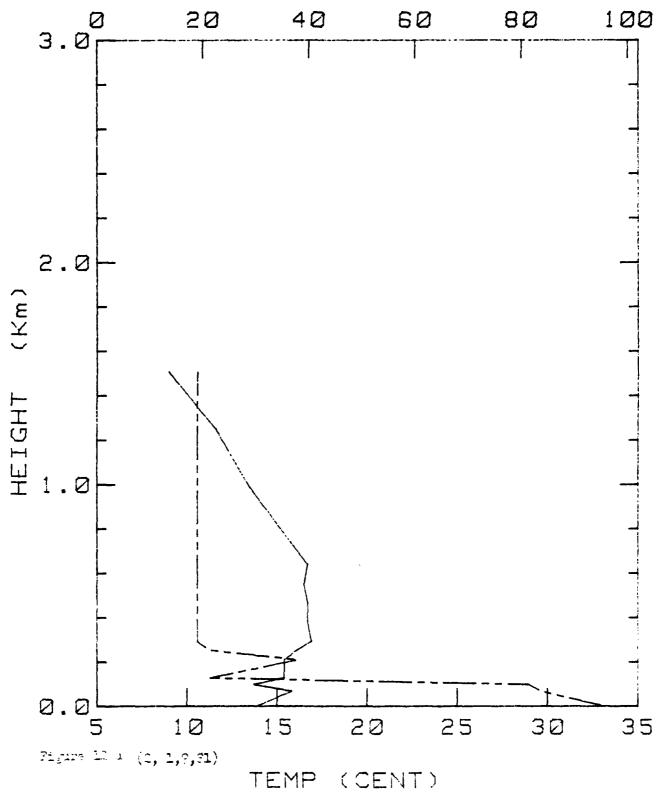
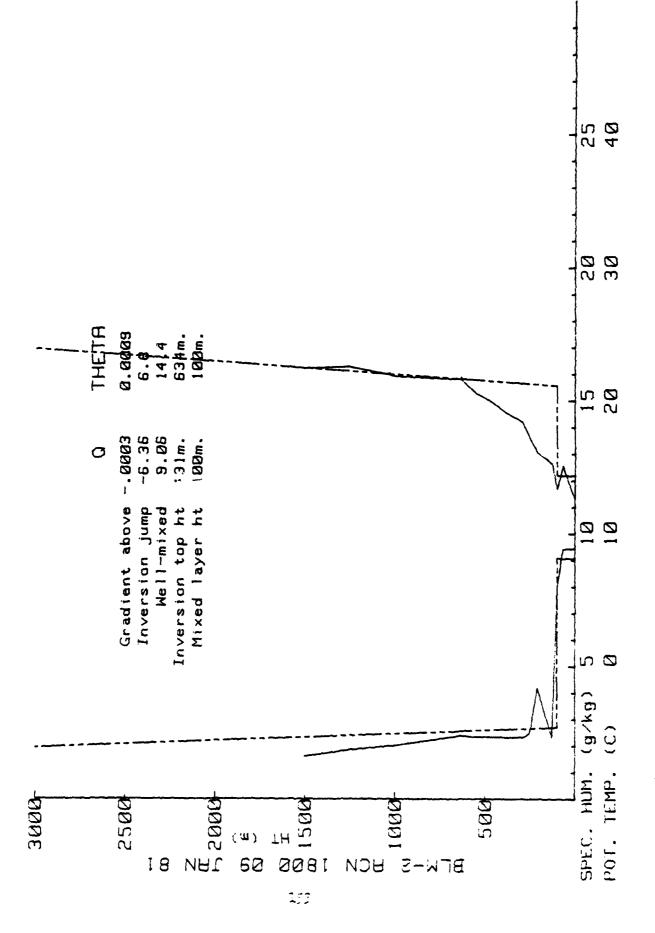


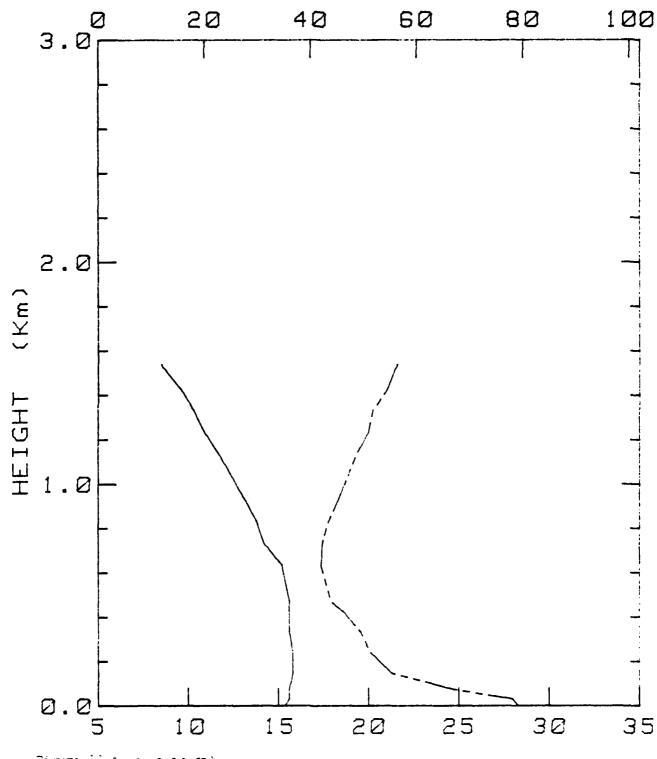
Figure 1: b (2, 1,9,01)



BLM-II Ø9 JAN 81 1800

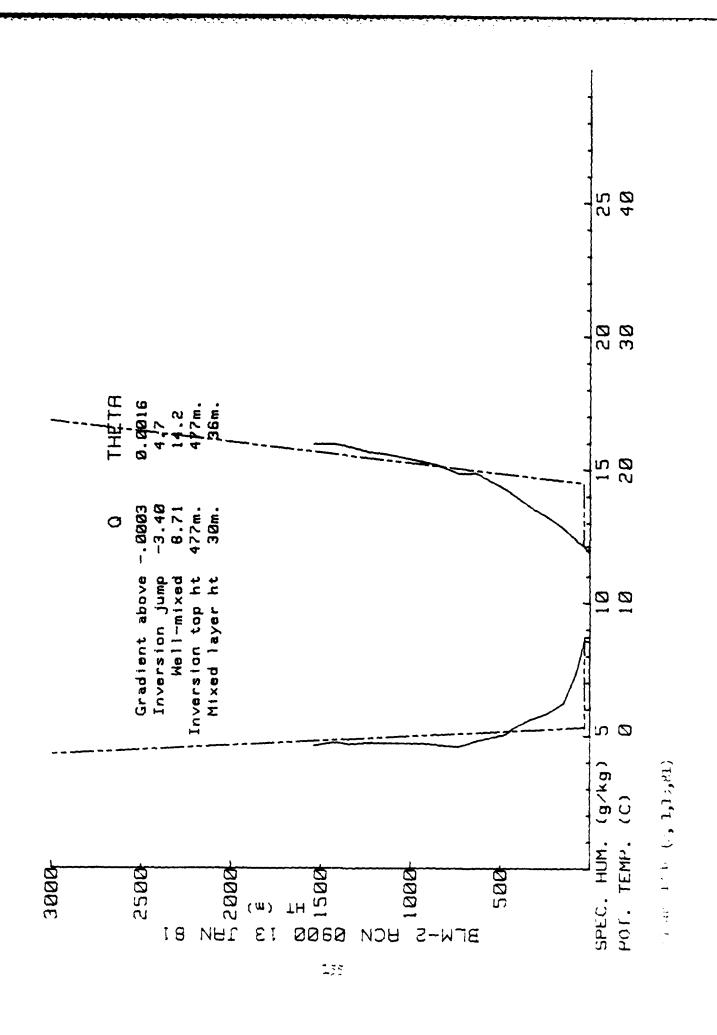


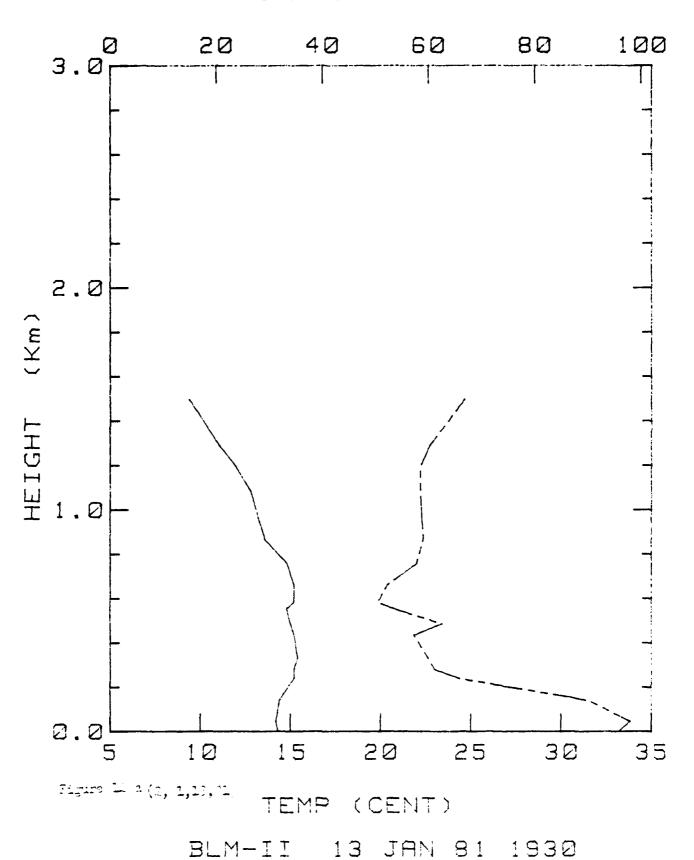
(19,2,1,9,81)

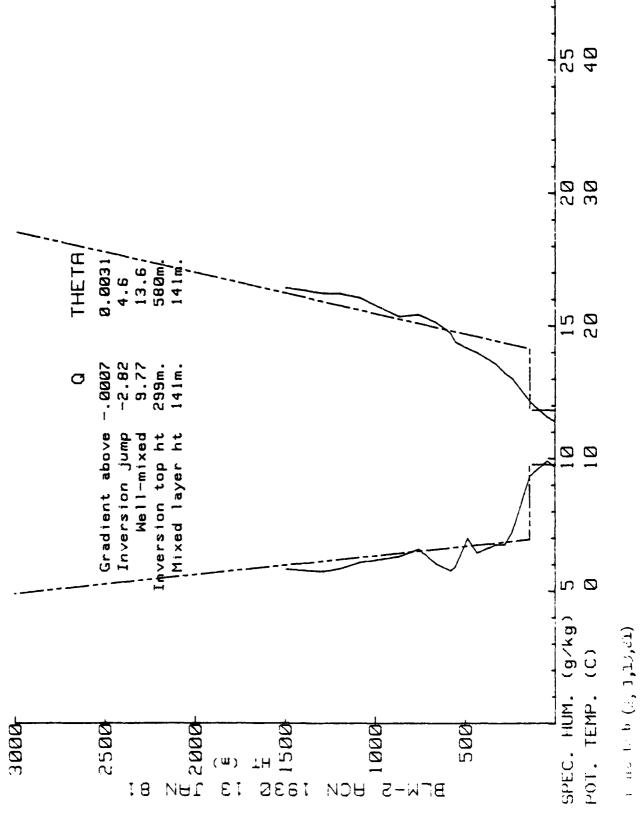


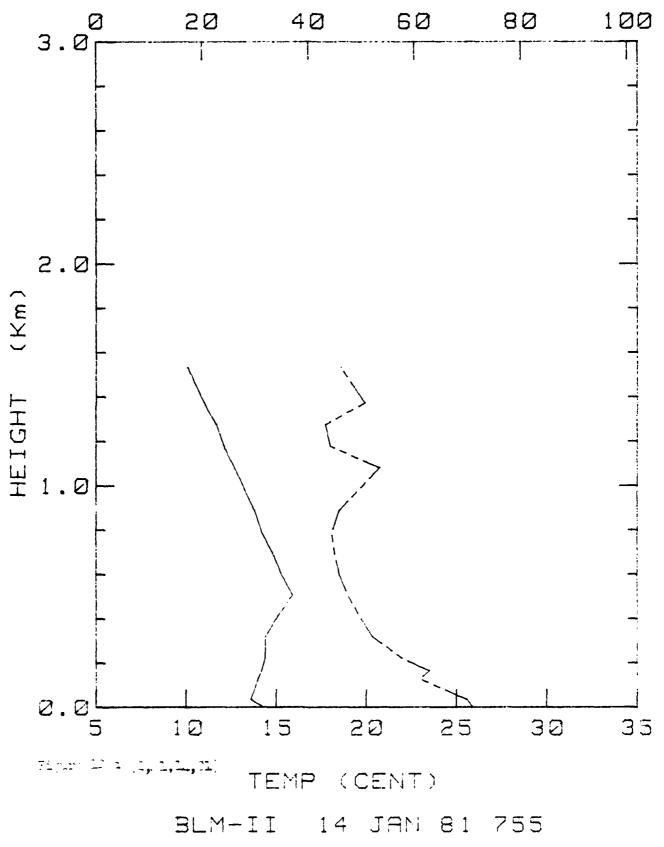
71gure 11 ( 2, 1,12,71) TEMP (CENT)

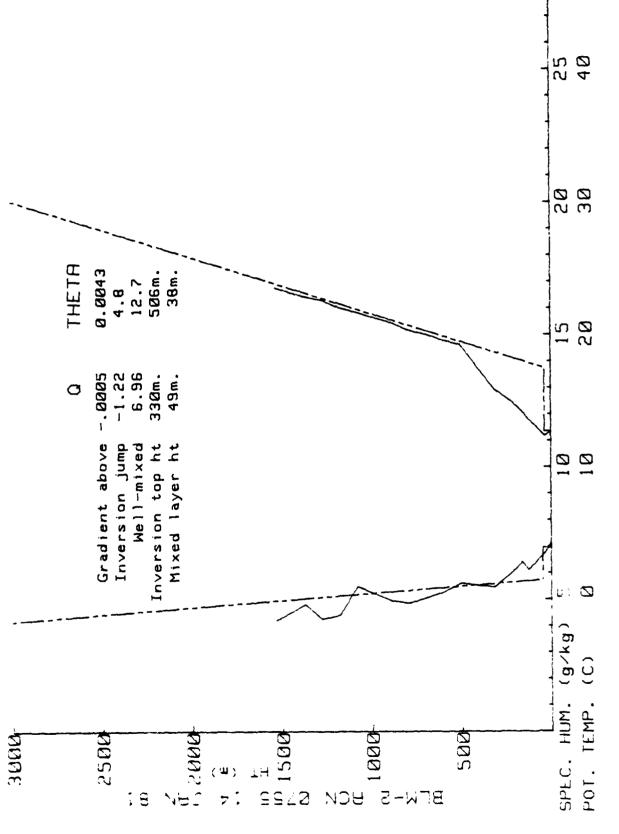
BLM-2 13 JAN 81 900



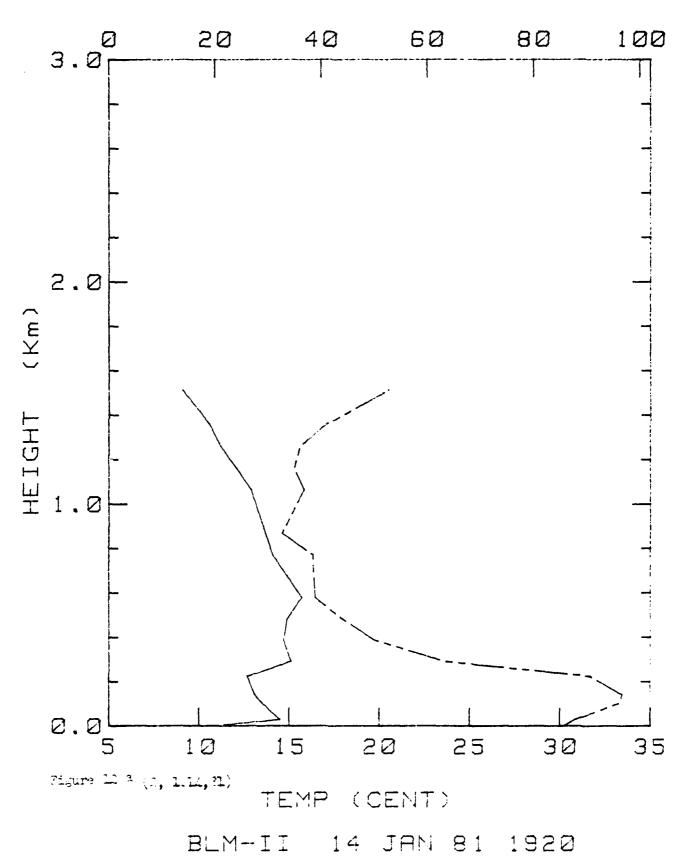


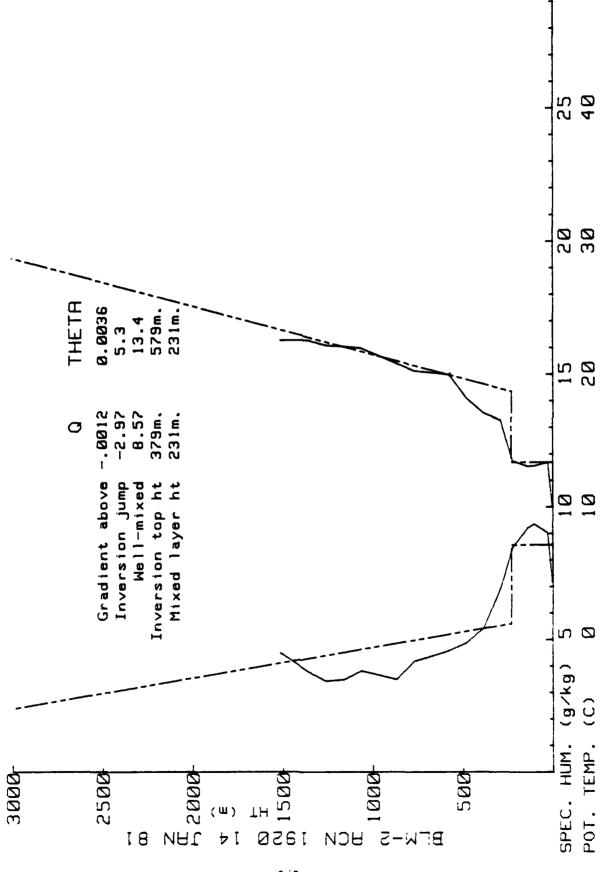




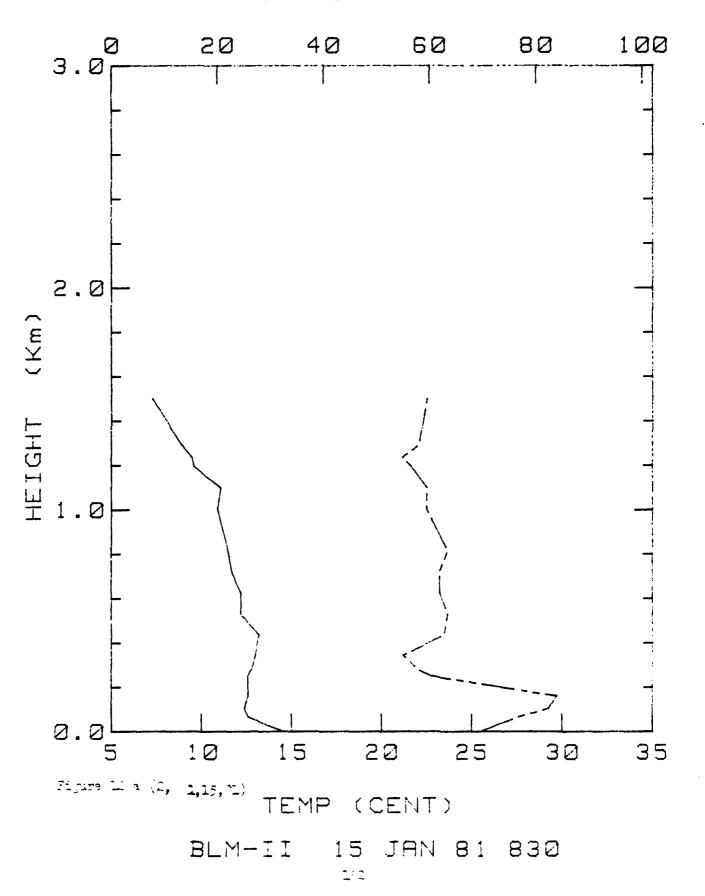


(18,11,1,1) d (1,11,1)





11, at 17 b (2, 1, 14, 1)



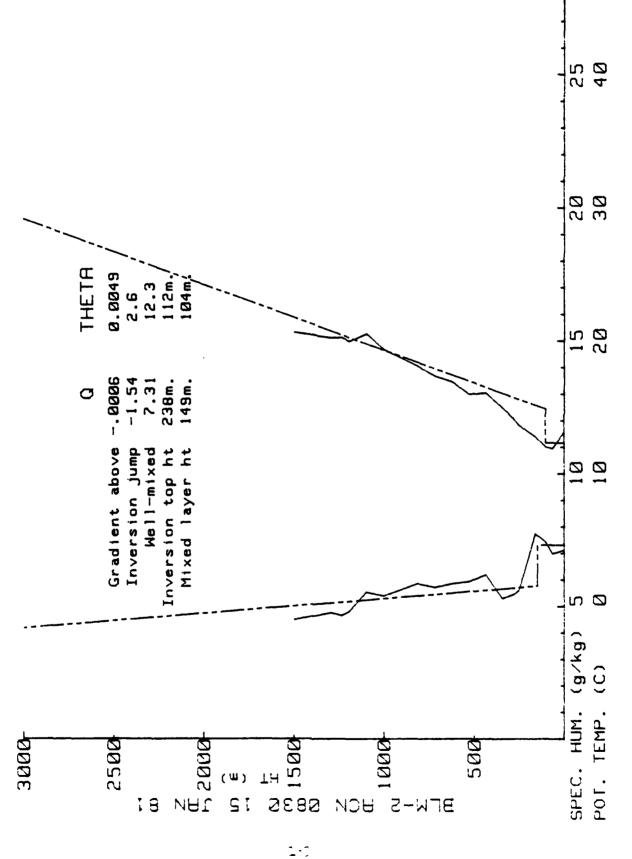
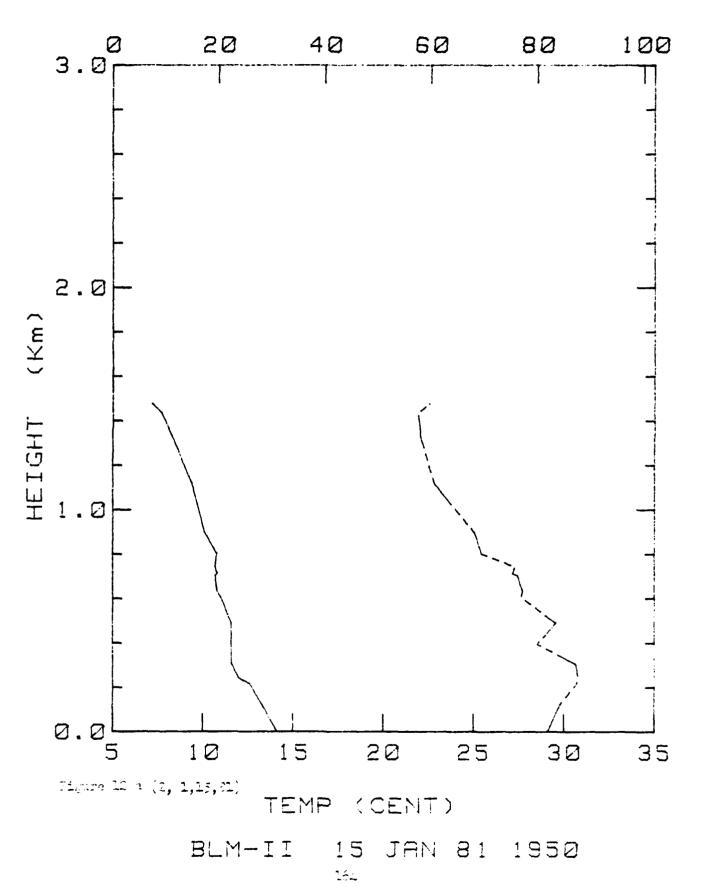
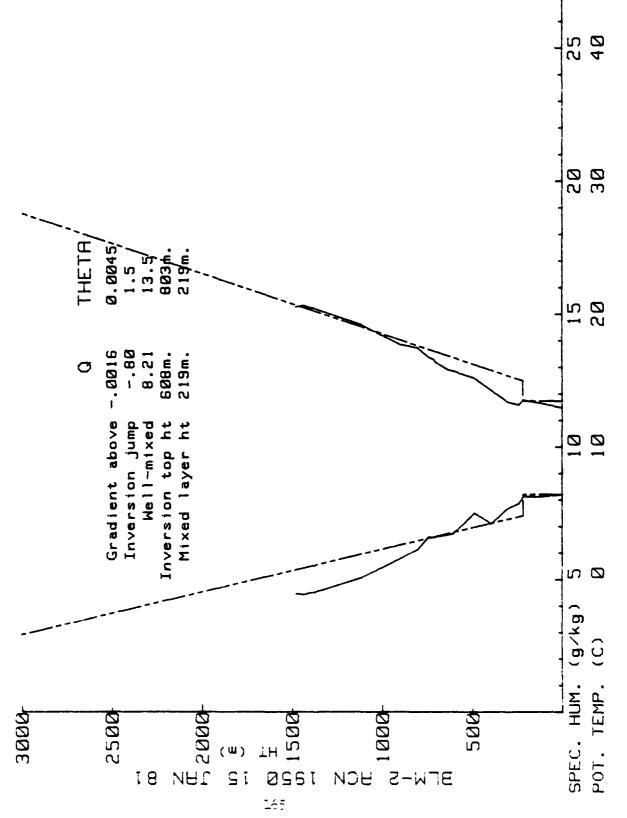
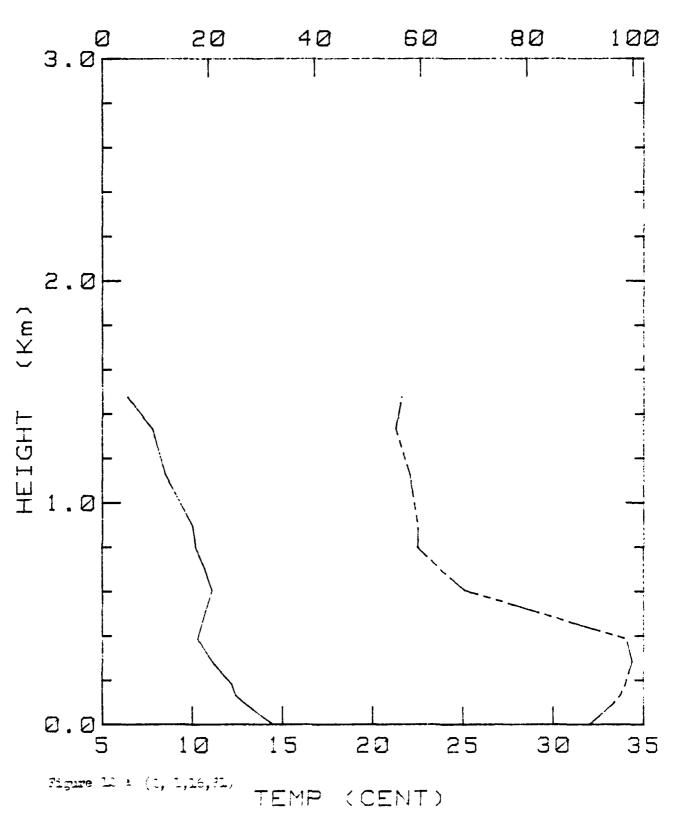


Figure 4: to (7, 1,15,81)

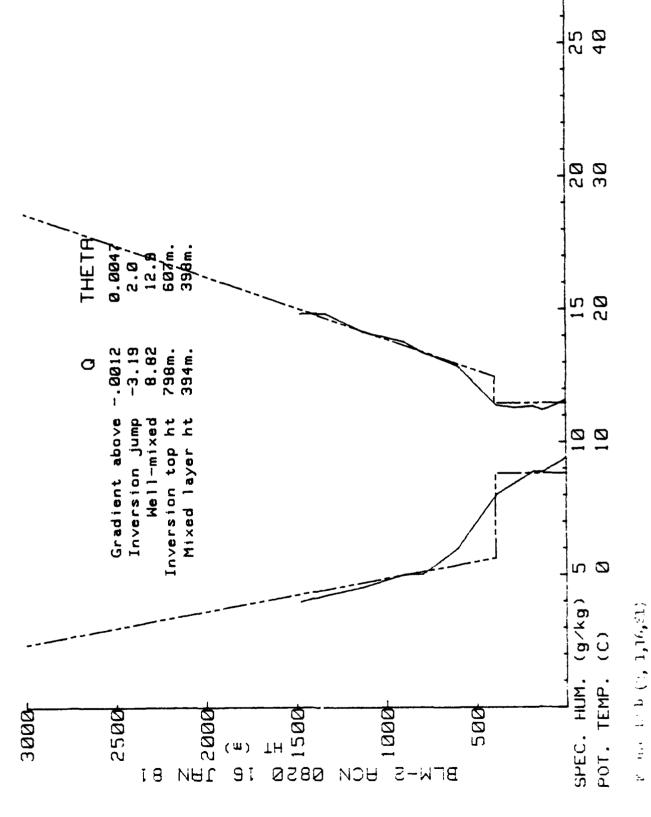


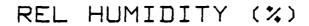


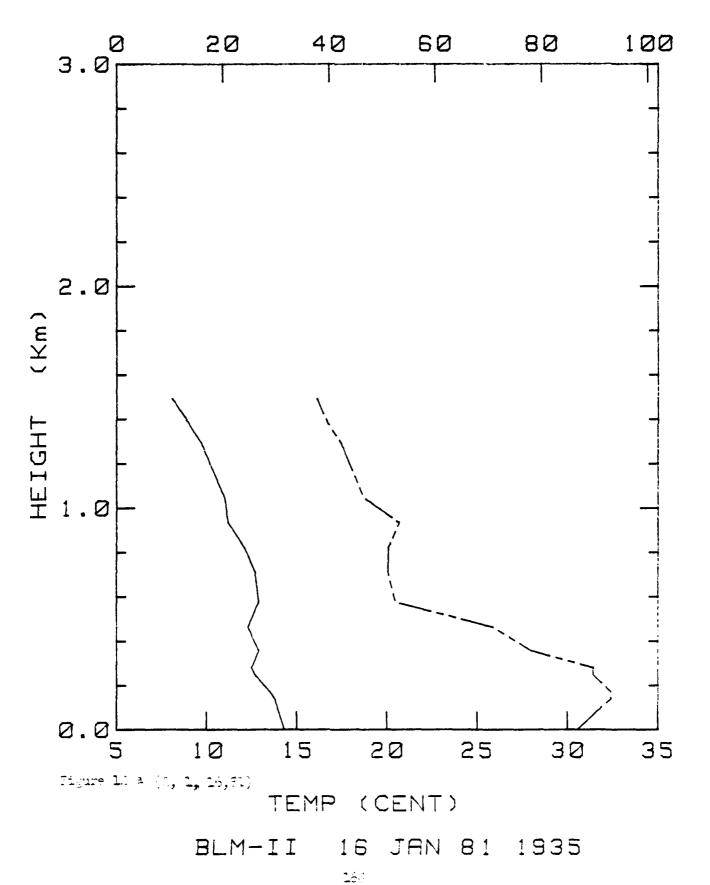
ED 1 1 15.31



BLM-II 16 JAN 81 820







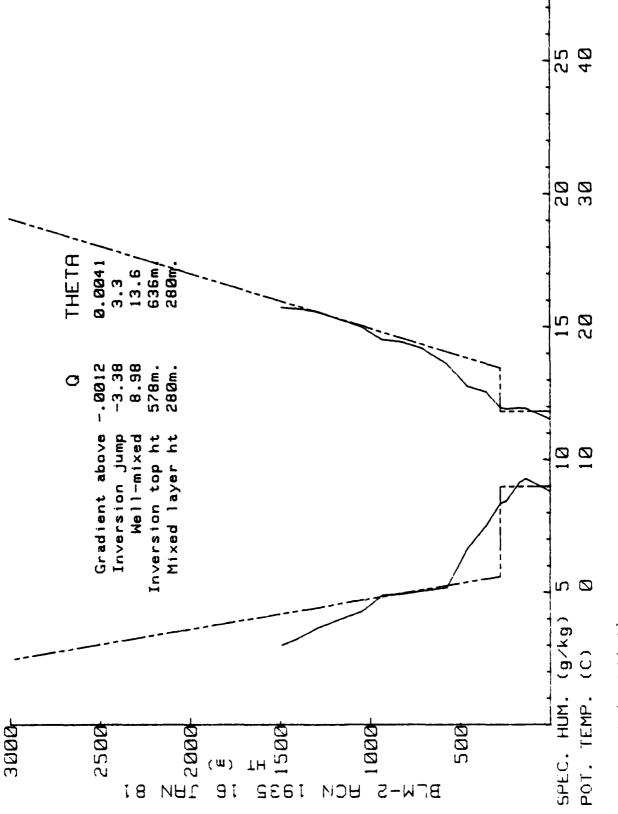
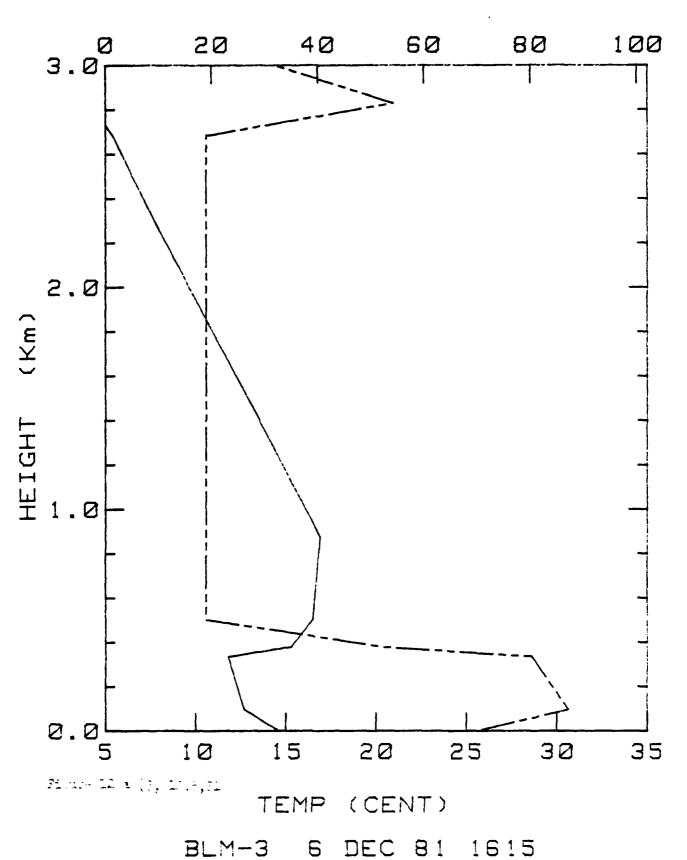
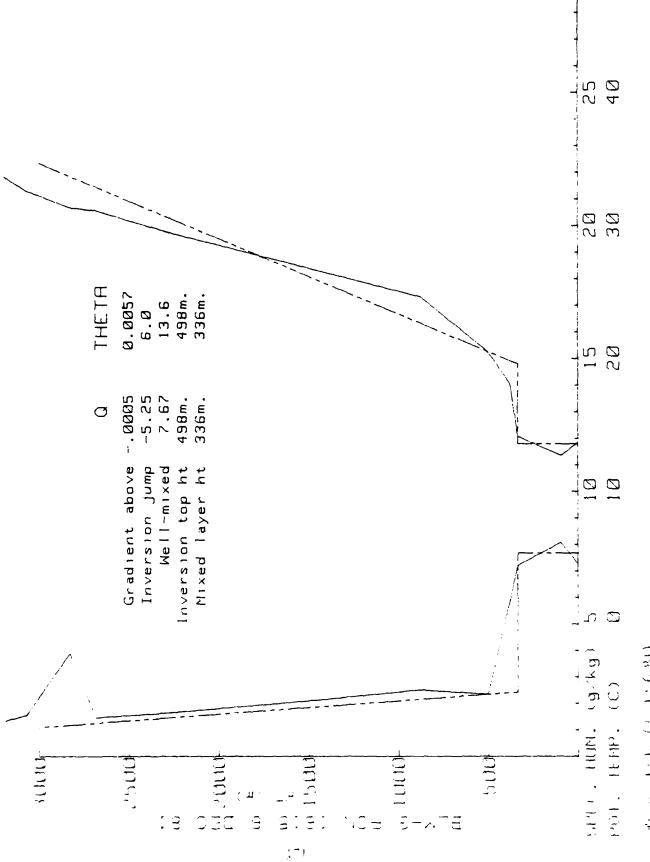
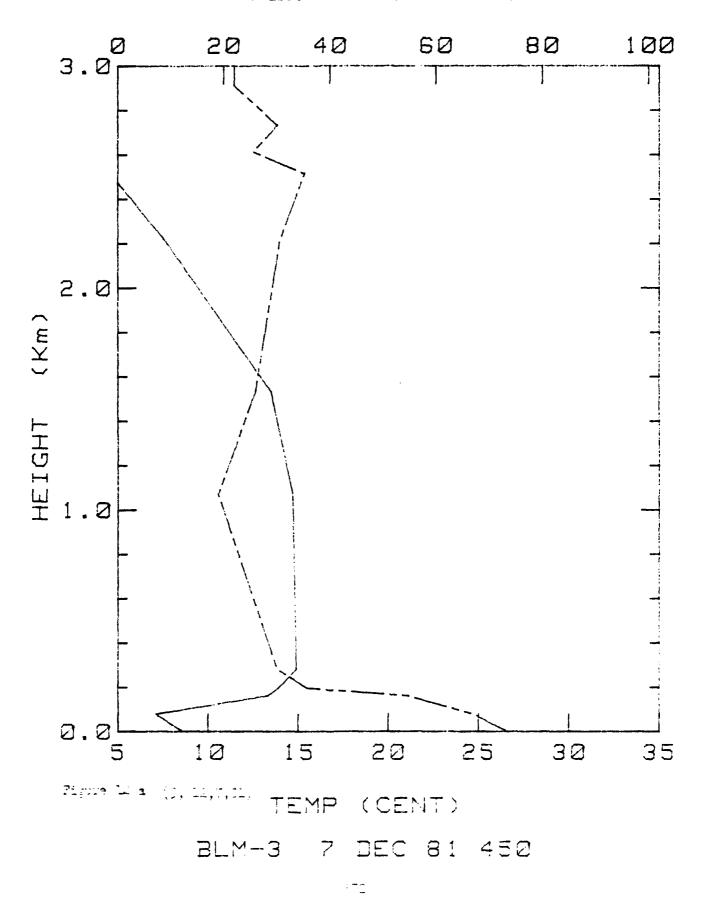


Figure 12 b (5, 1, 16, 31)





Star Lib (3, 12,6,81)



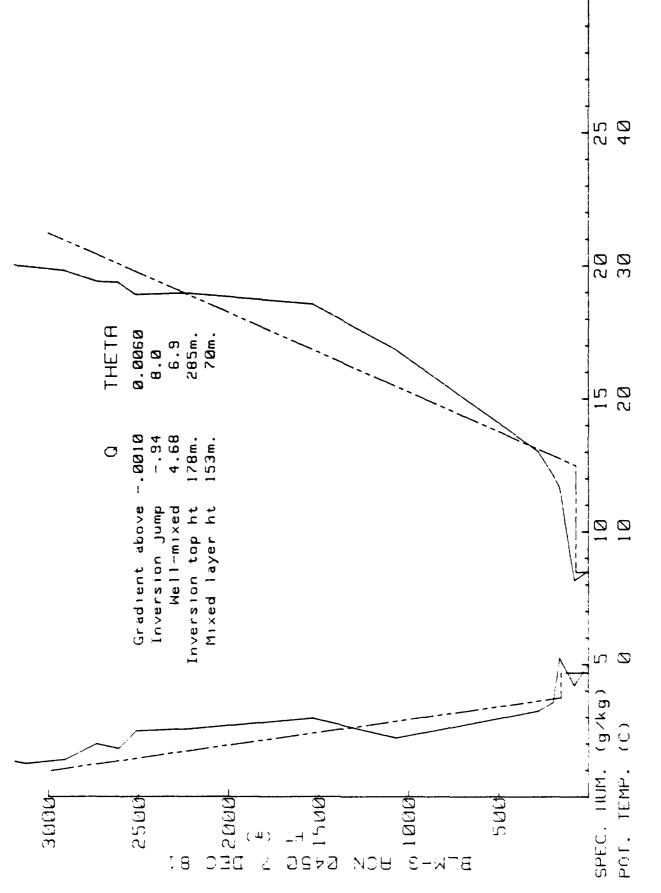
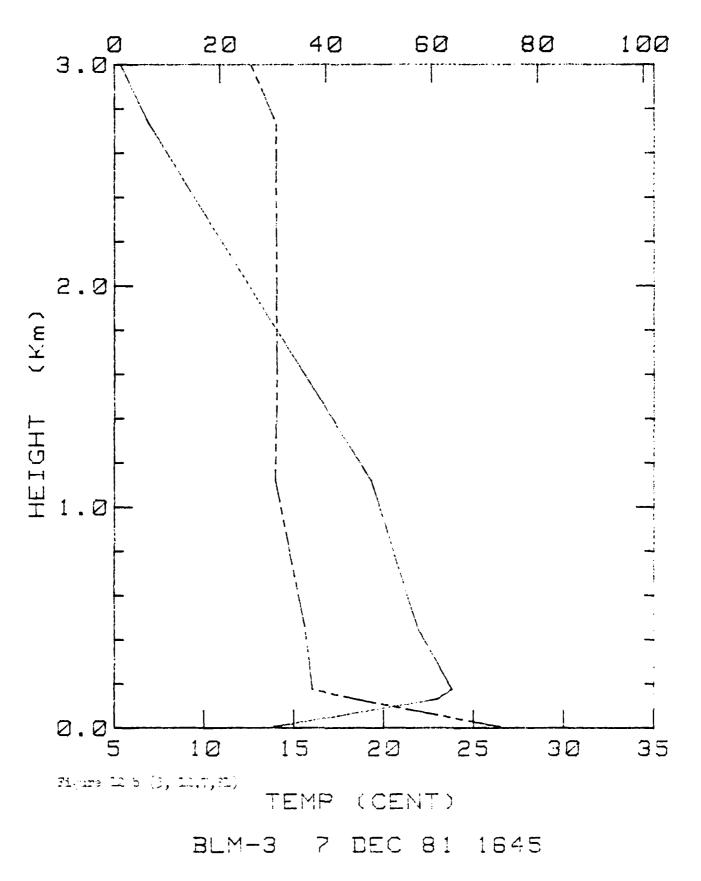
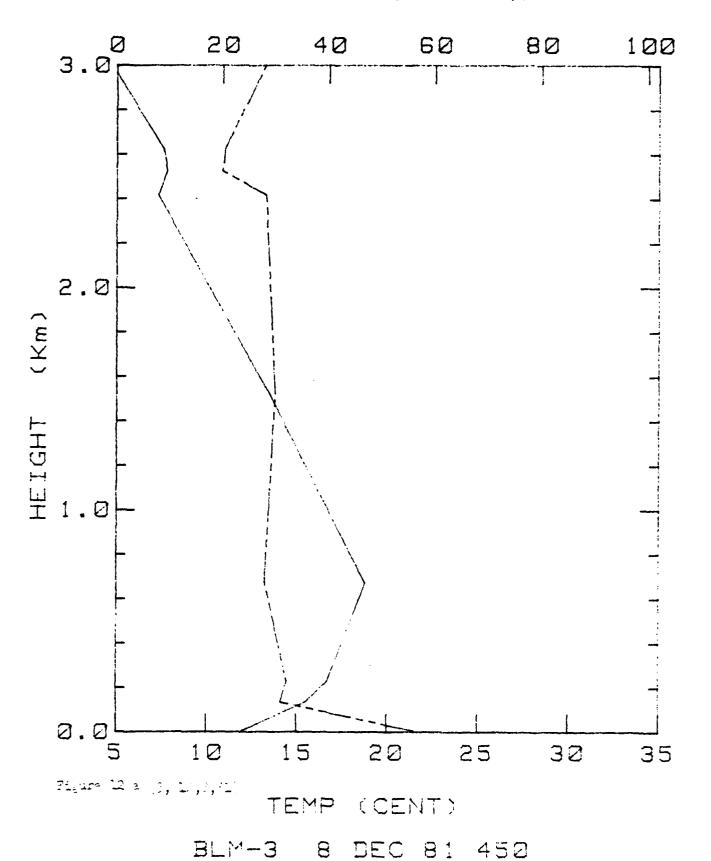
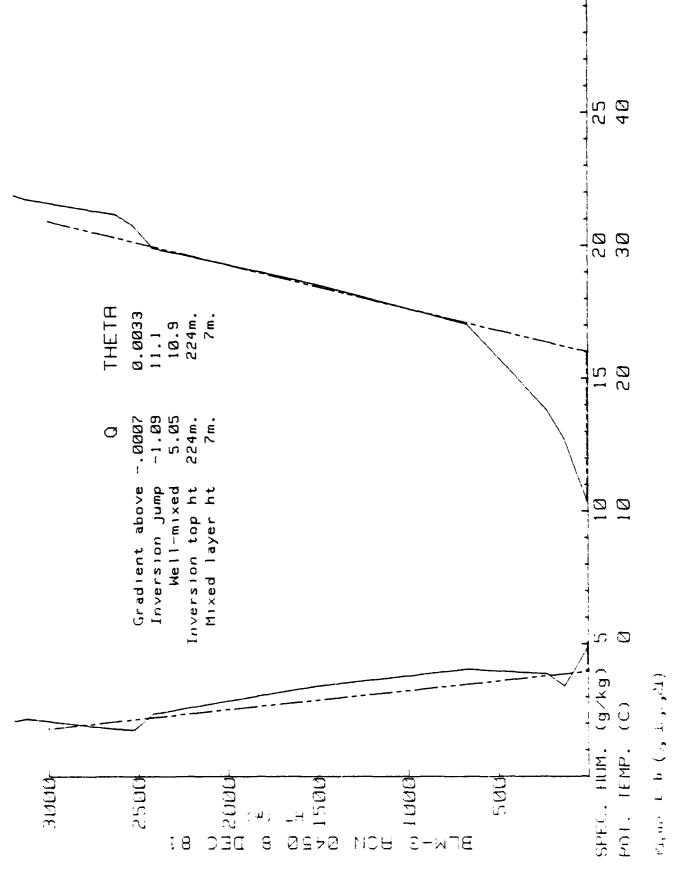


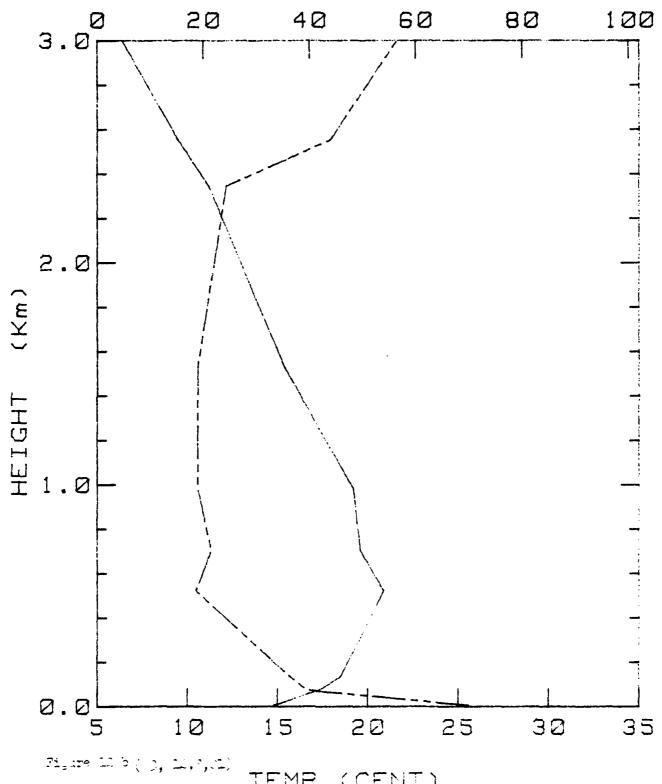
Figure ( b (c, L, 1,21)



85, 1 b b (5, 1, 7, 80)

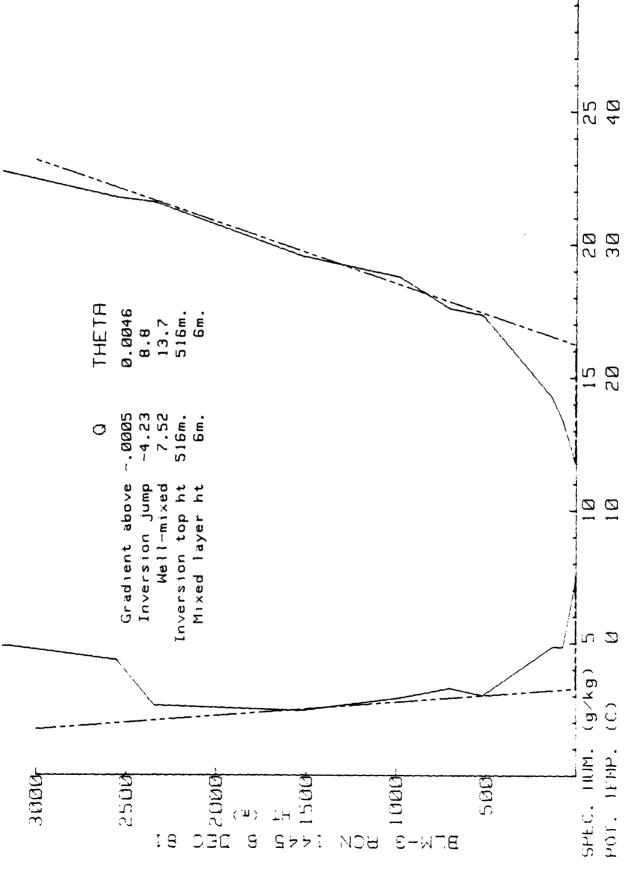






TEMP (CENT)

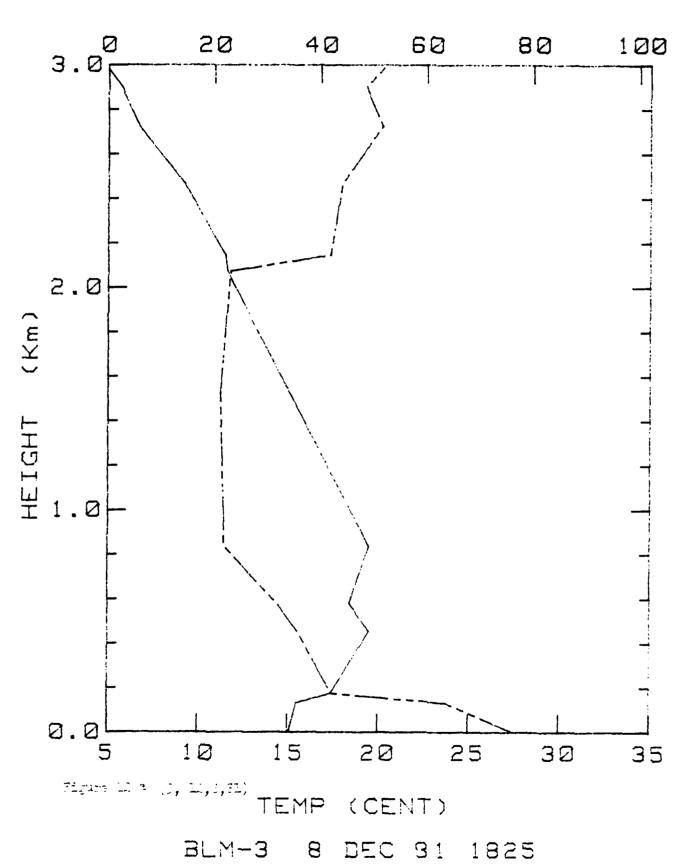
BLM-3 8 DEC 81 1445

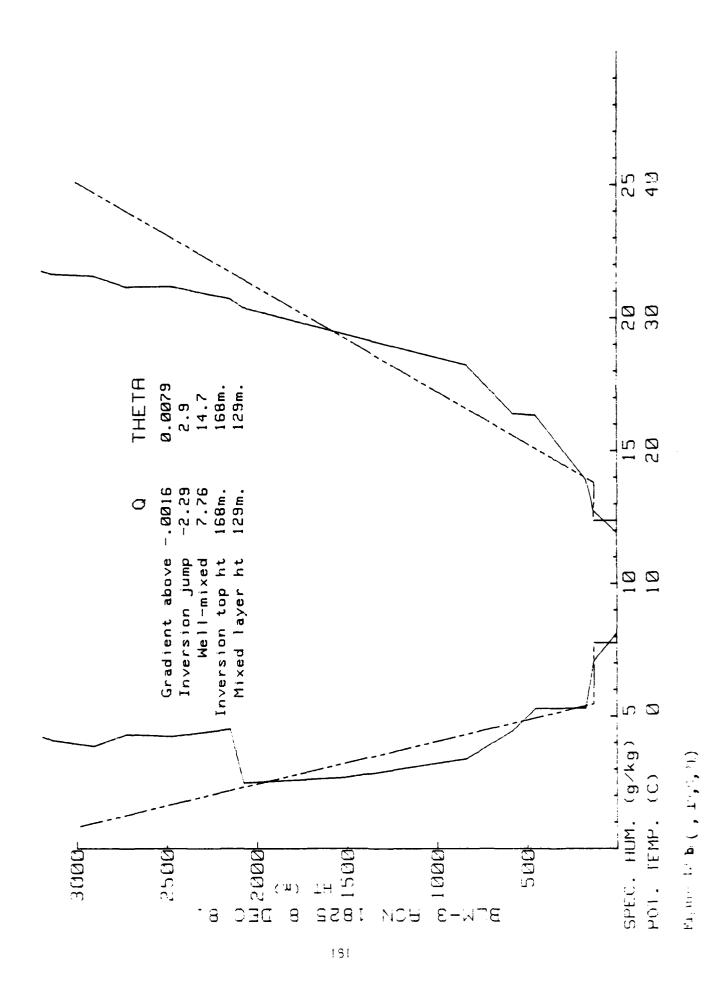


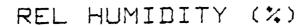
C

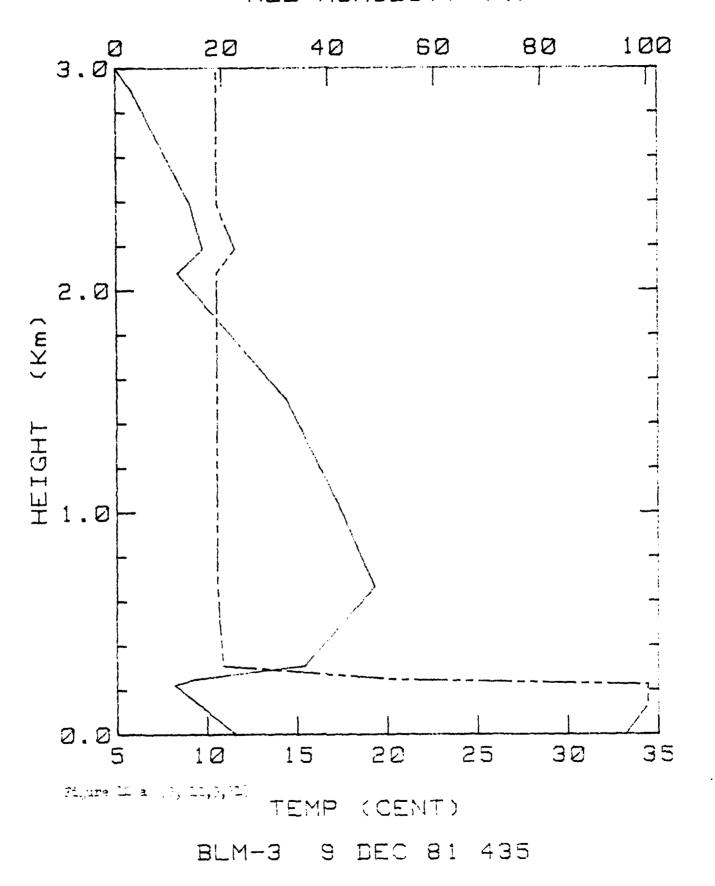
Aires L' b (5, 1, 5,3)

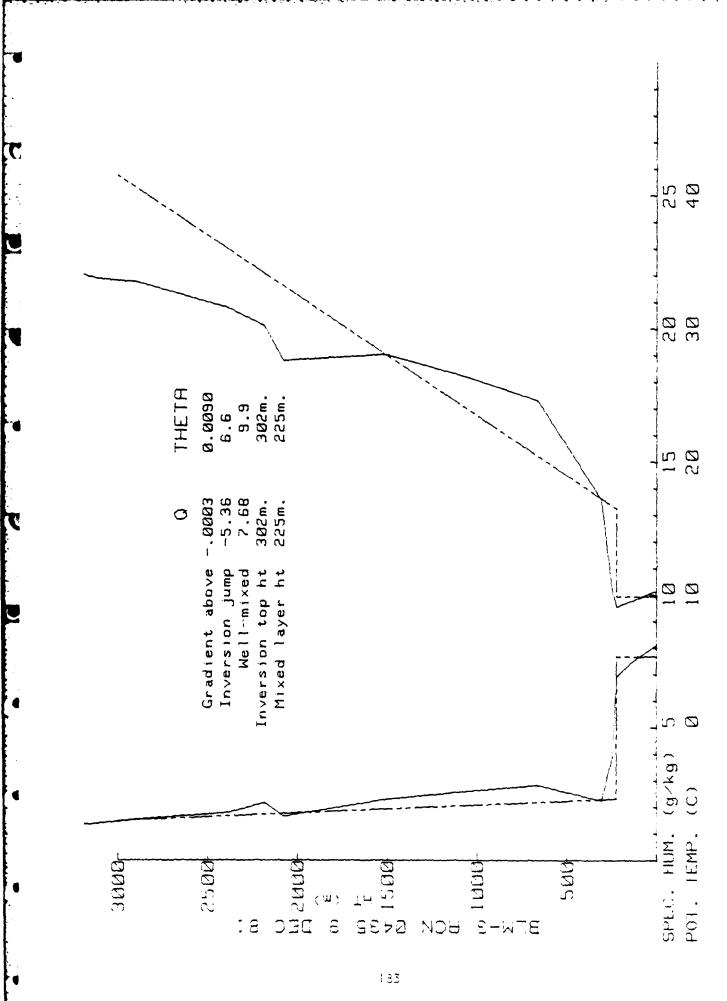
ı



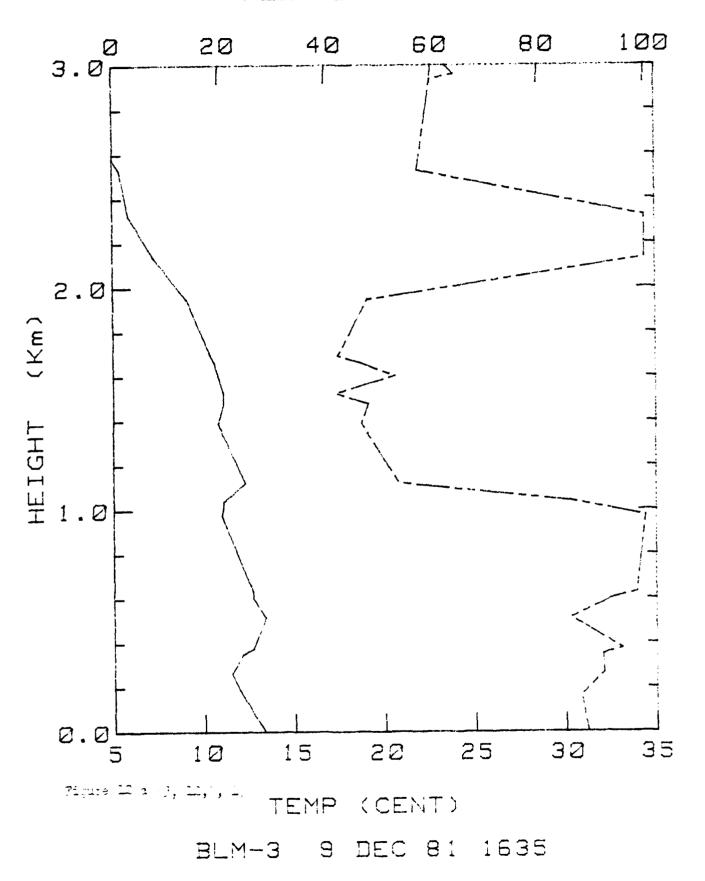


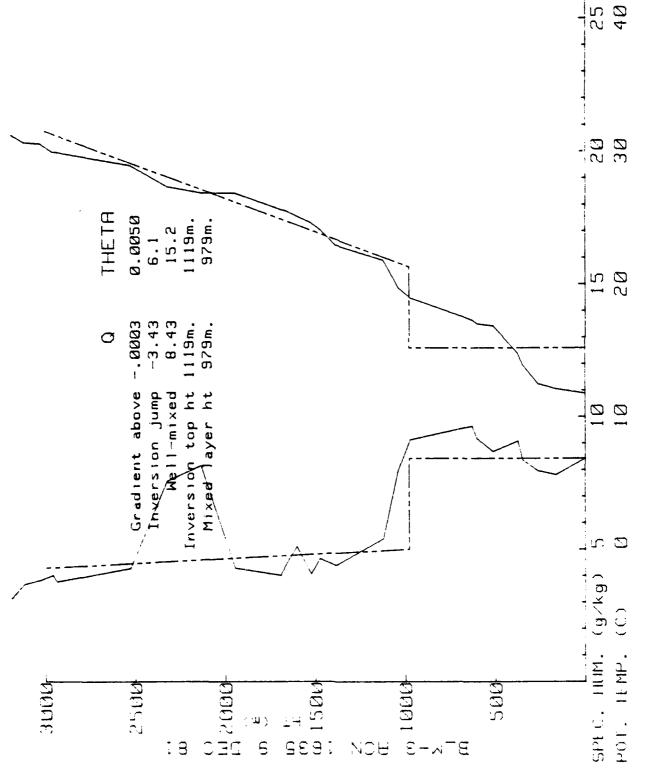


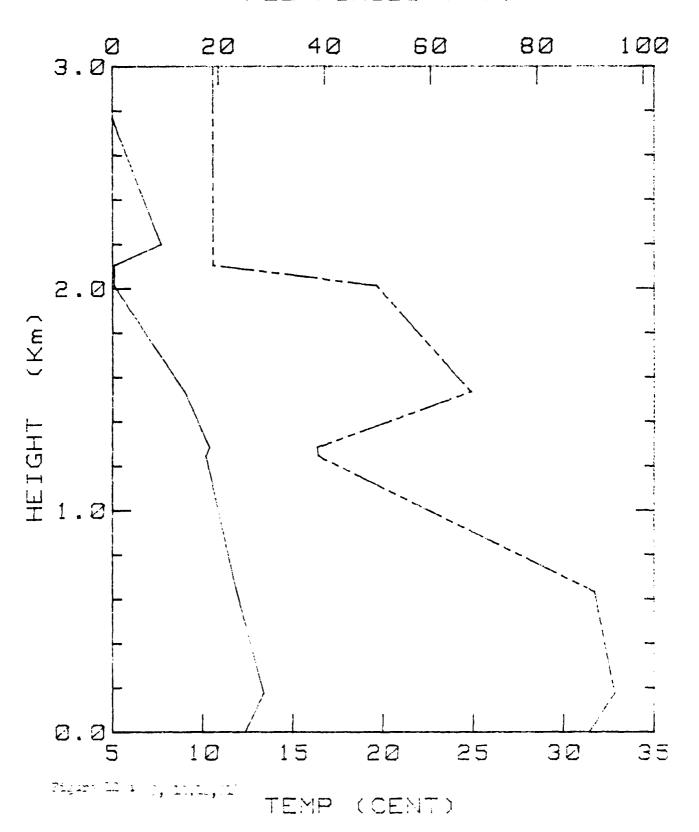




Physical B (5, 1959)

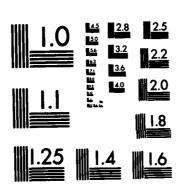




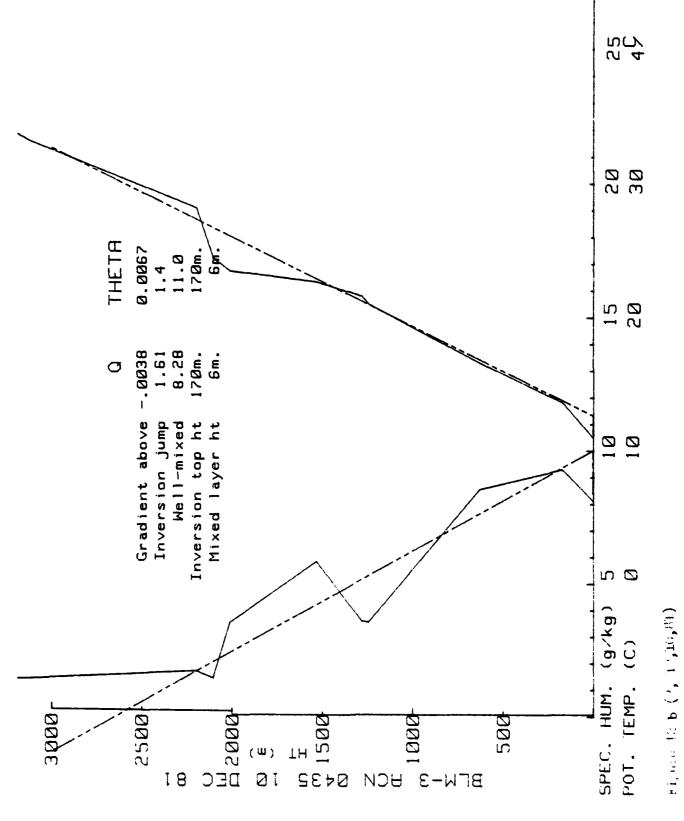


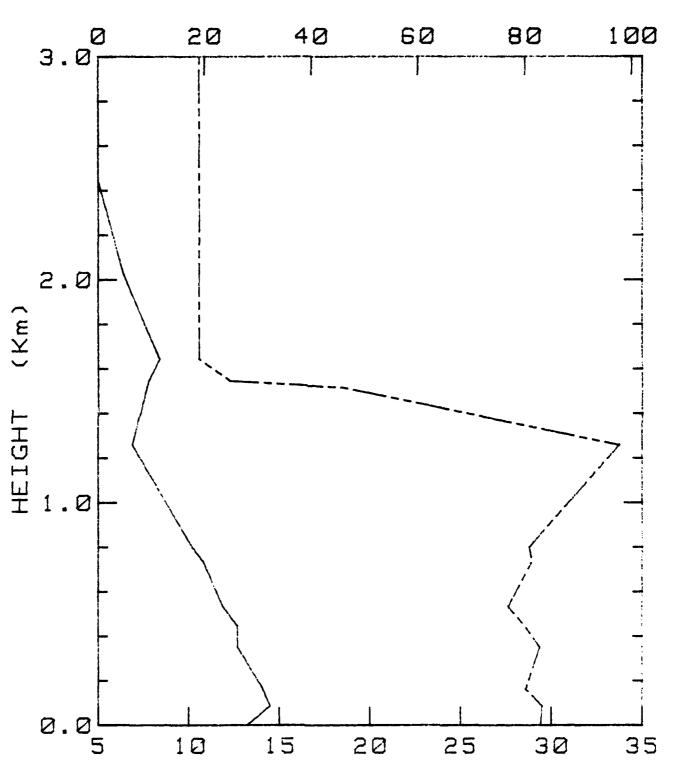
BLM-3 10 DEC 81 435

CALIFORNIA COASTAL OFFSHORE TRANSPORT AND DIFFUSION EXPERIMENTS - METEORO. (U) NAVAL POSTGRADUATE SCHOOL MONTEREY CA G E SCHACHER ET AL. 86 DEC 82 NPS-61-82-887 F/G 4/2 AD-A123 582 3/5 UNCLASSIFIED NL



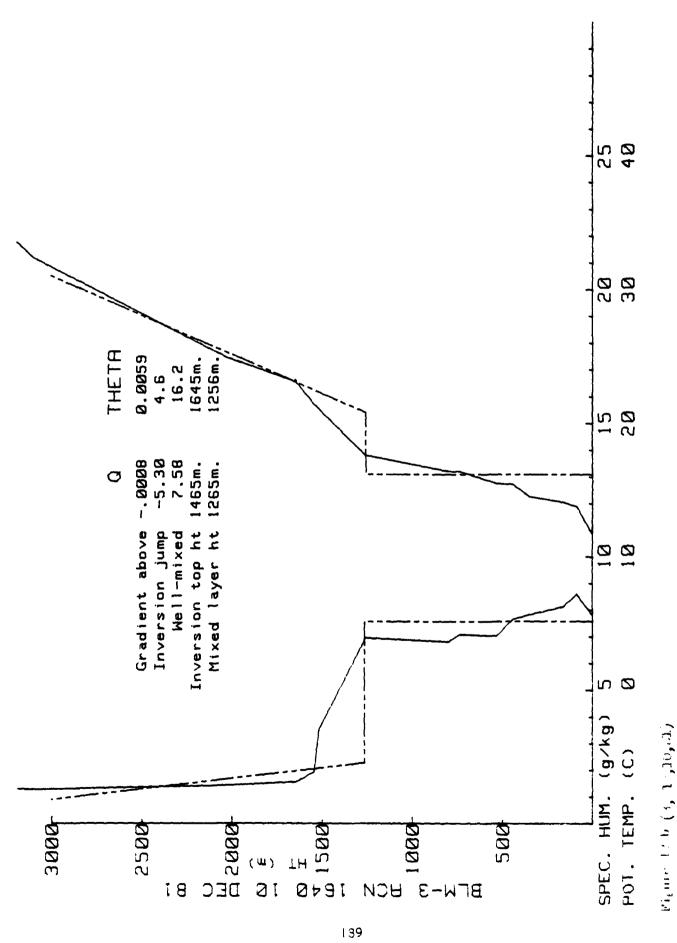
MICROCOPY RESOLUTION TEST CHART NATIONAL BUREAU OF STANDARDS-1963-A



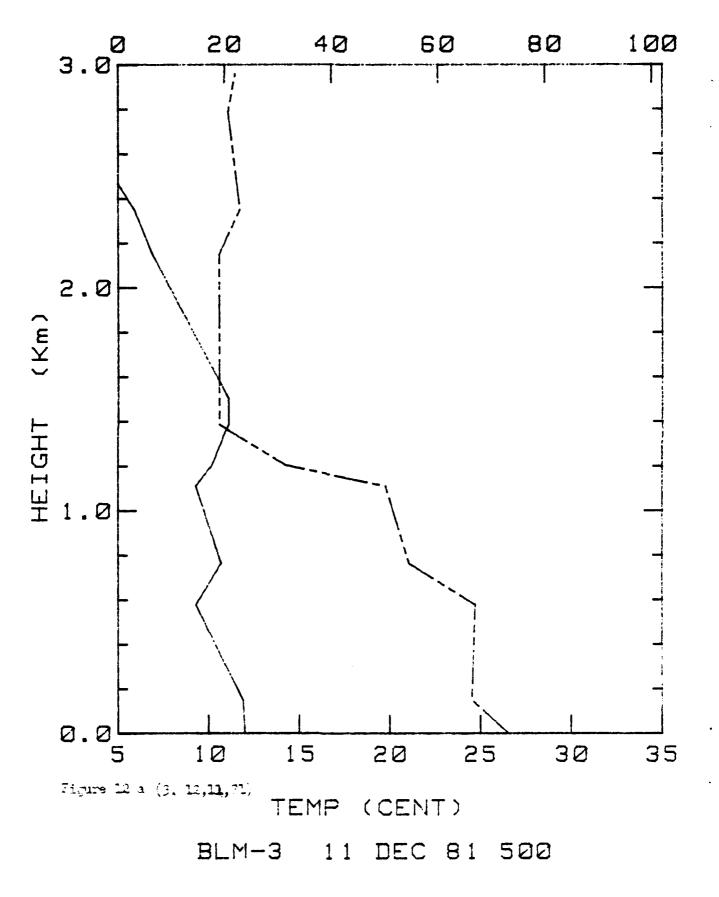


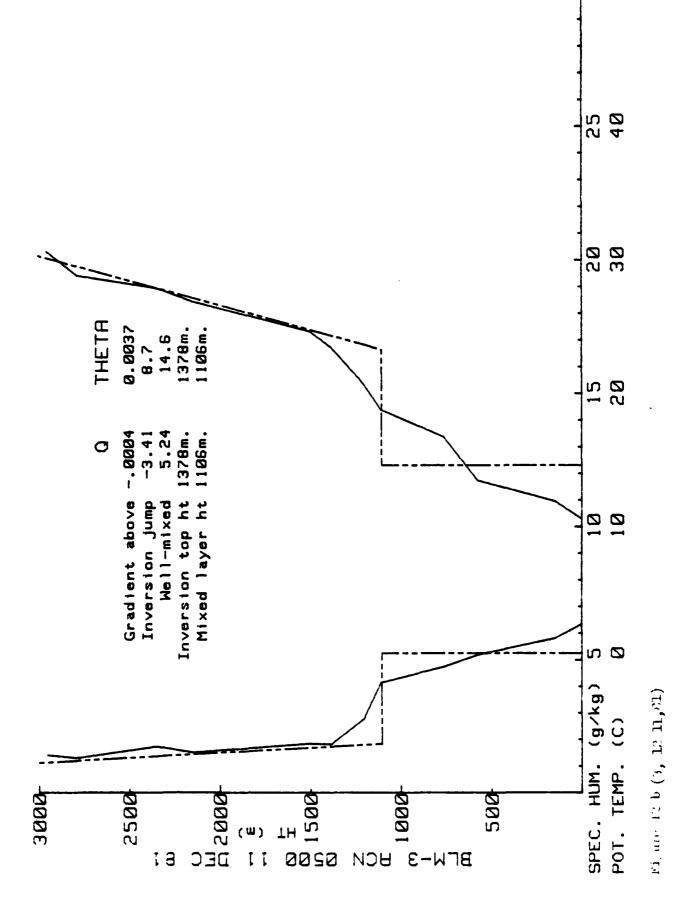
TEMP (CENT)

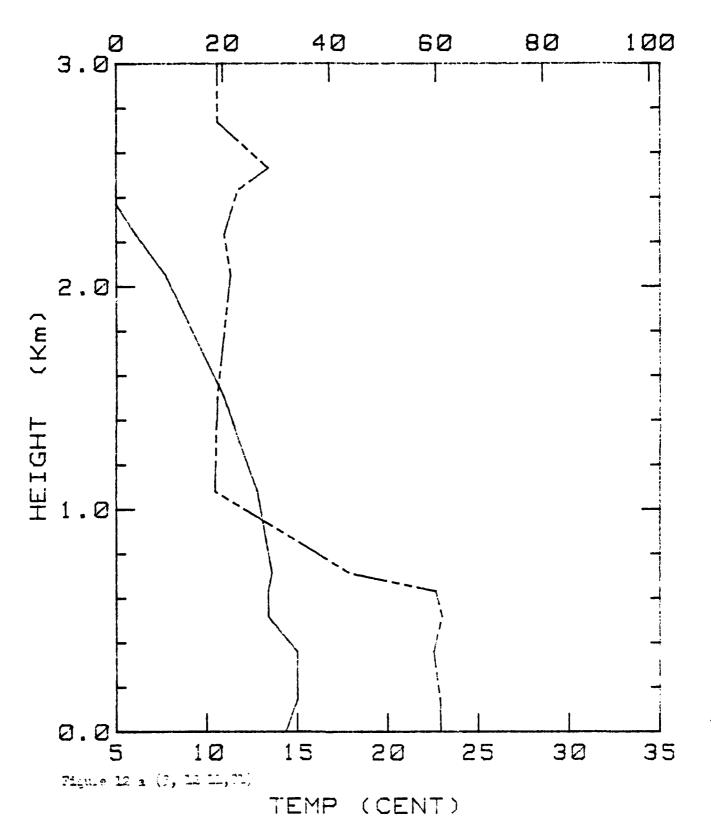
BLM-3 10 DEC 81 1640



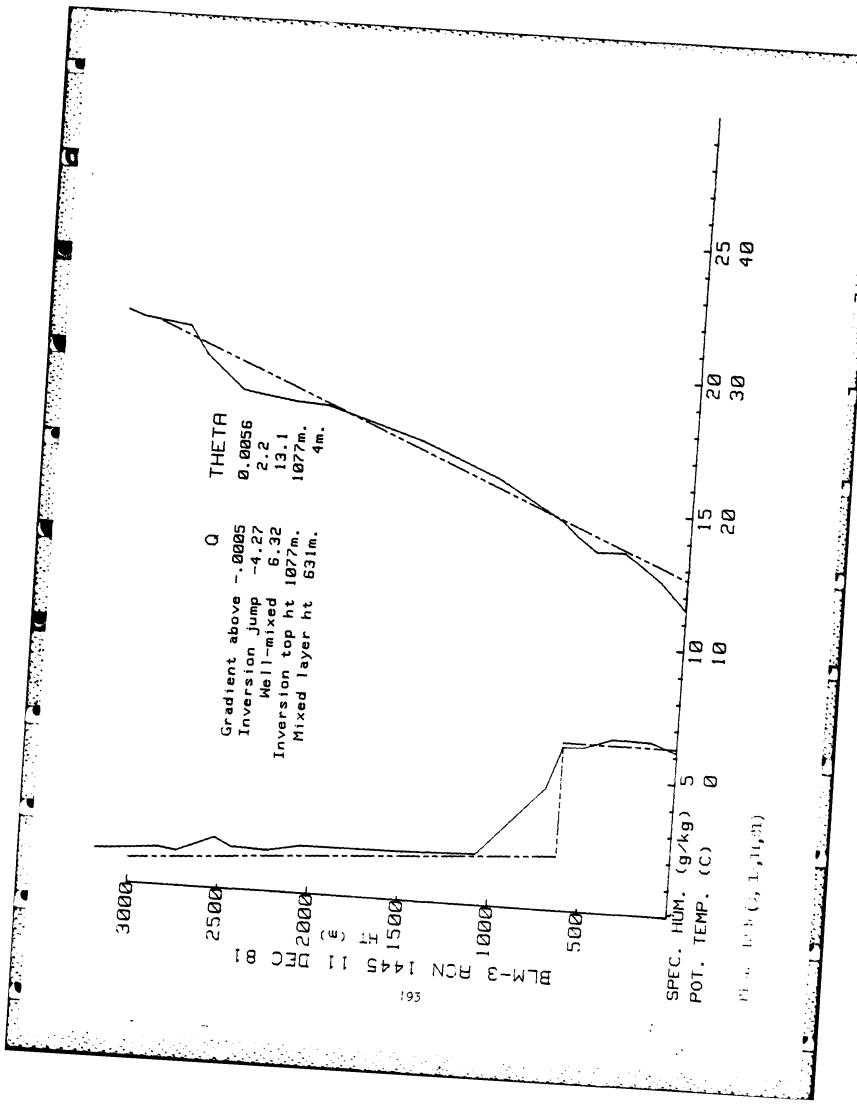
all heavy little in all hand earlies every house than

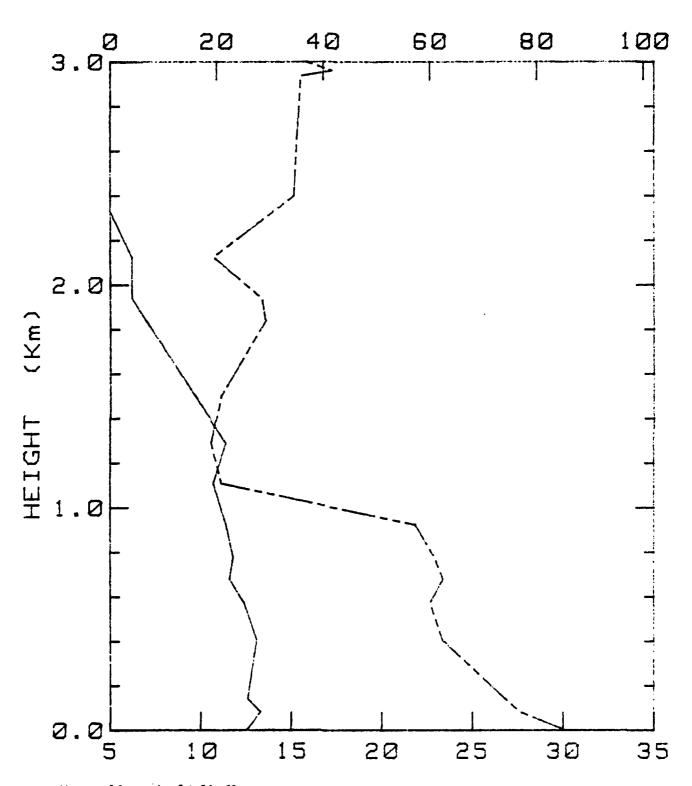






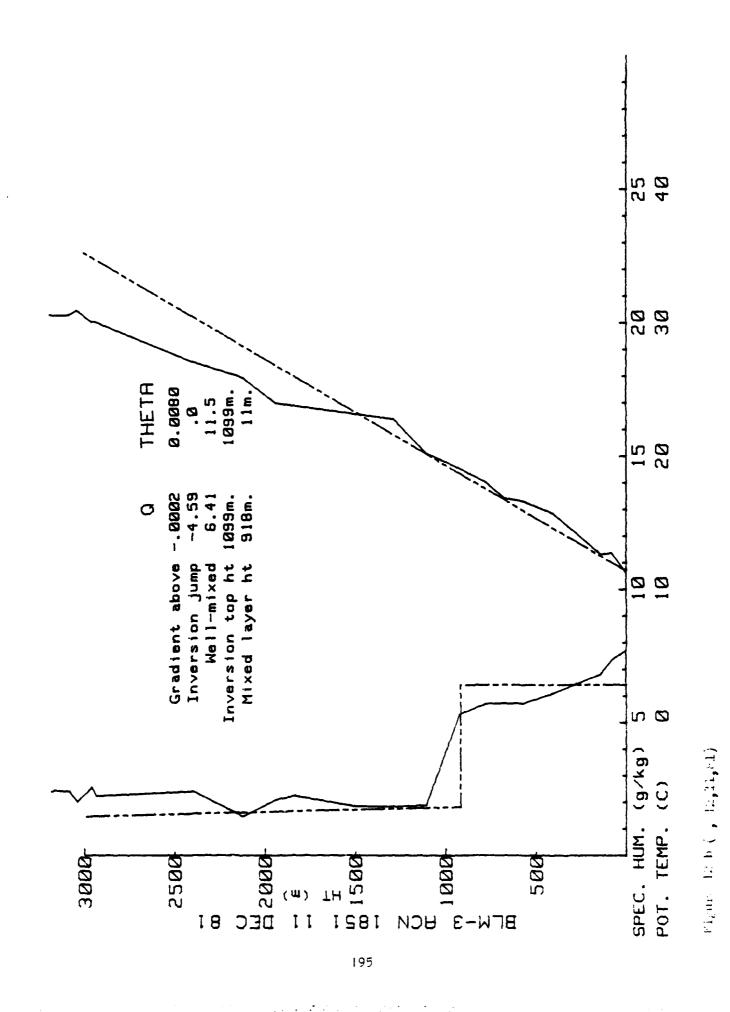
BLM-3 11 DEC 81 1445

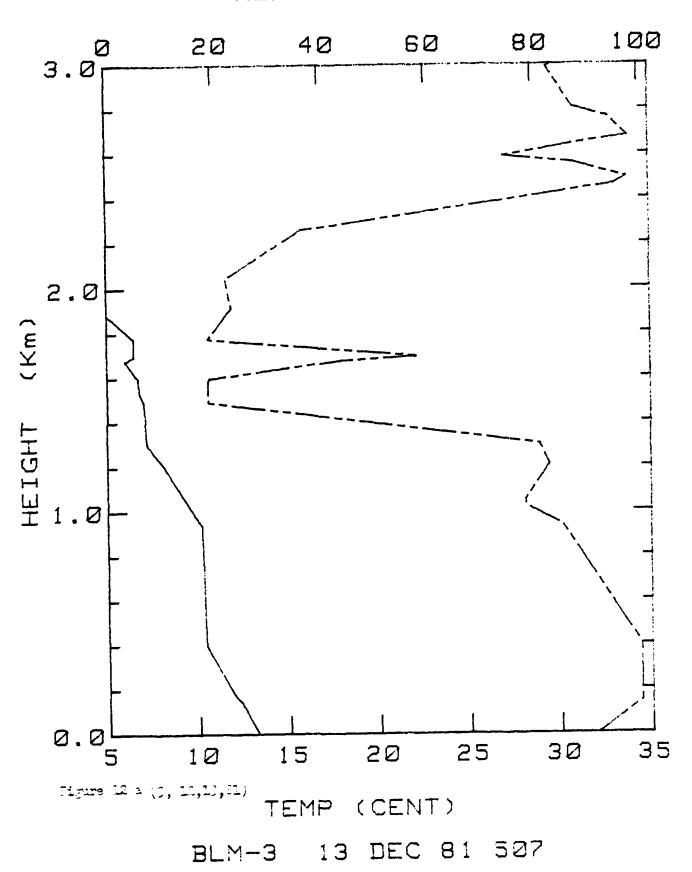


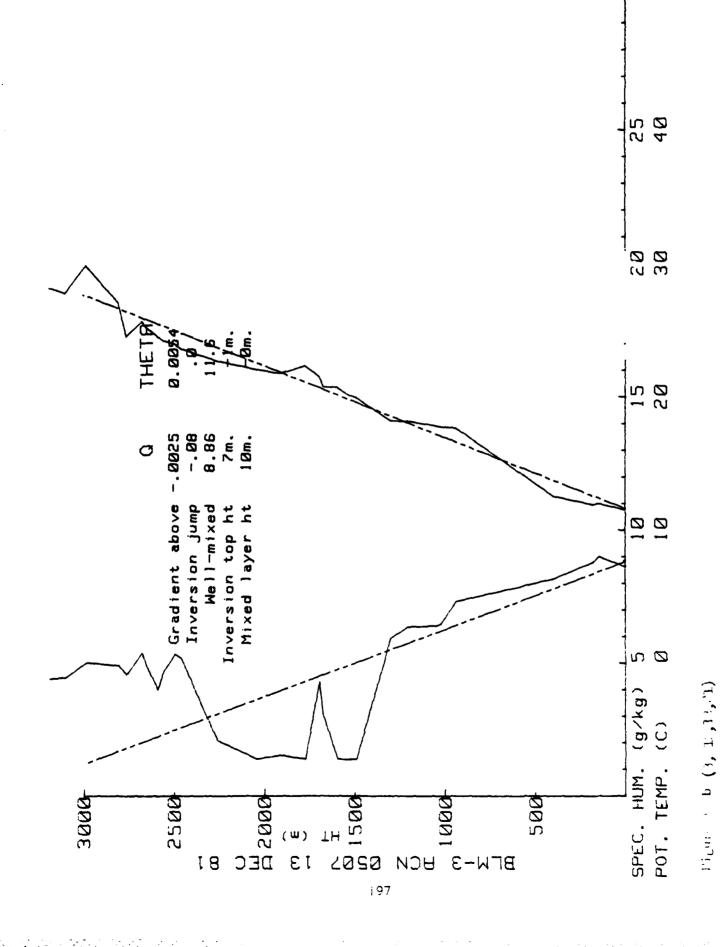


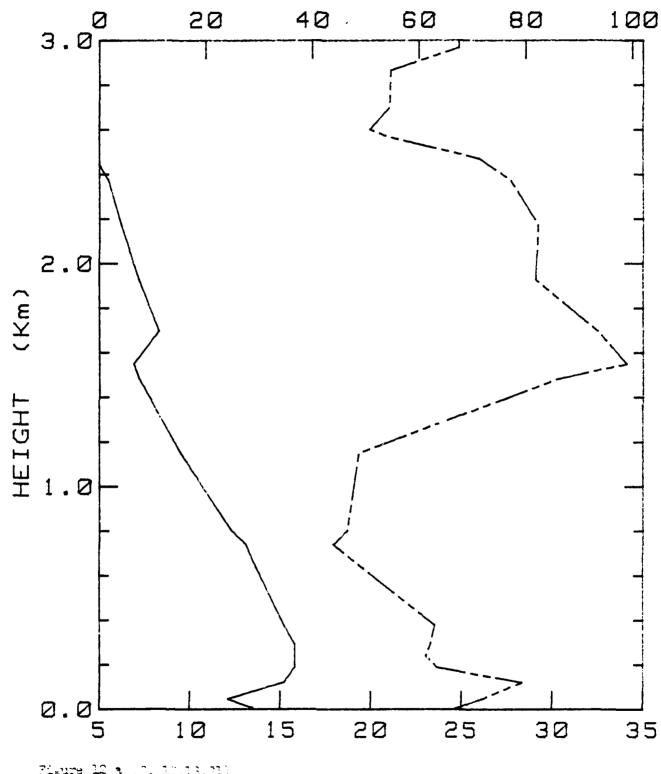
TEMP (CENT)

BLM-3 11 DEC 81 1851



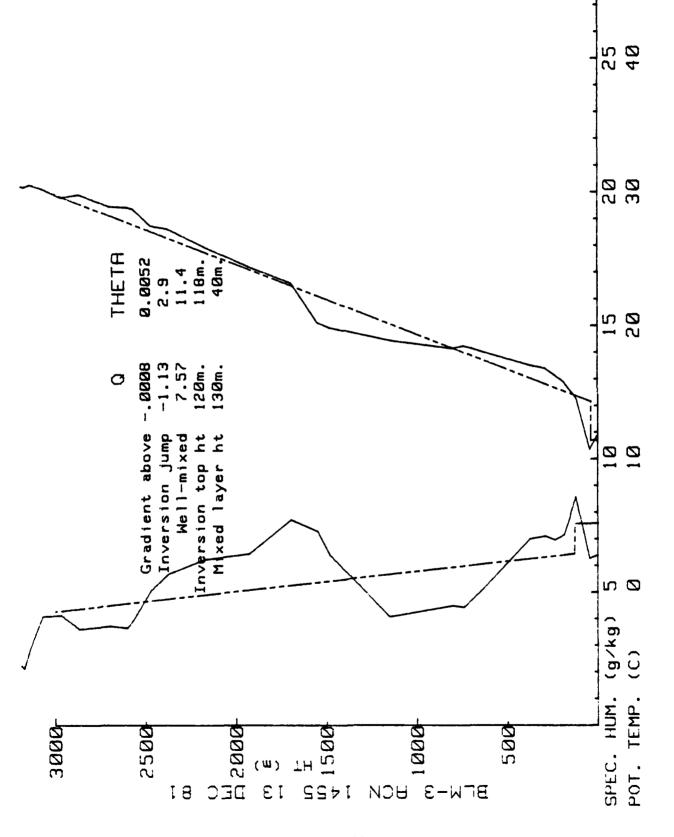




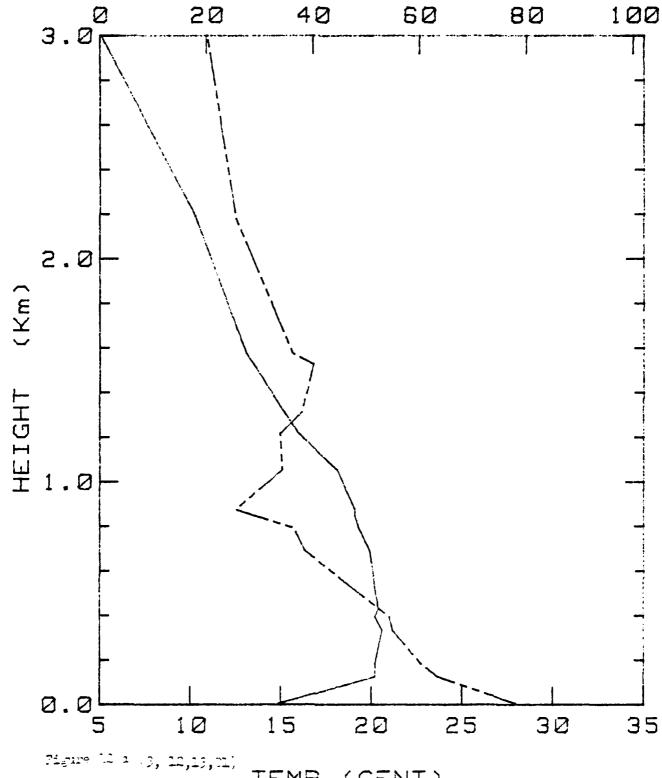


TEMP (CENT)

BLM-3 13 DEC 81 1455

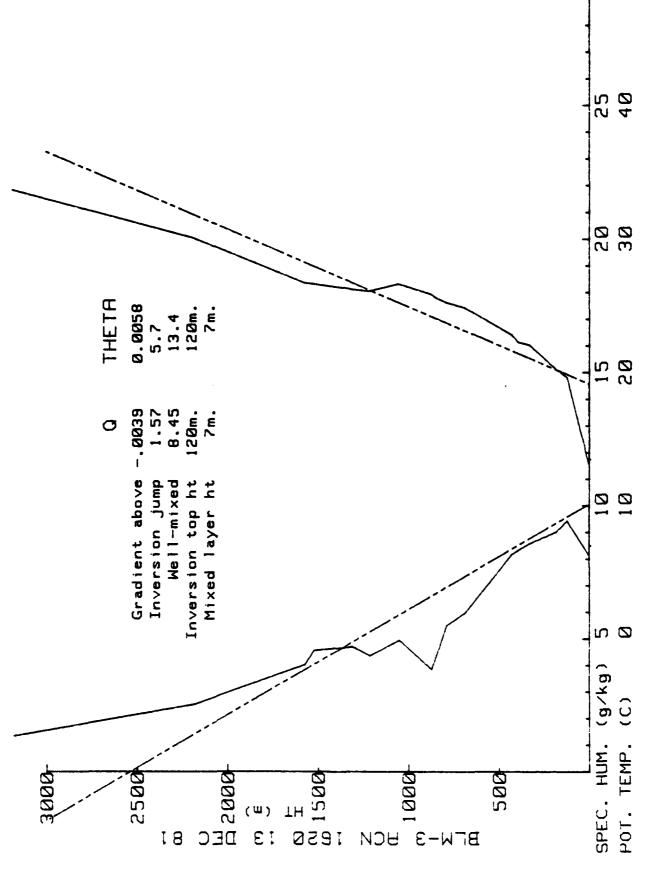


E are L' b (3, L', 15, 31)

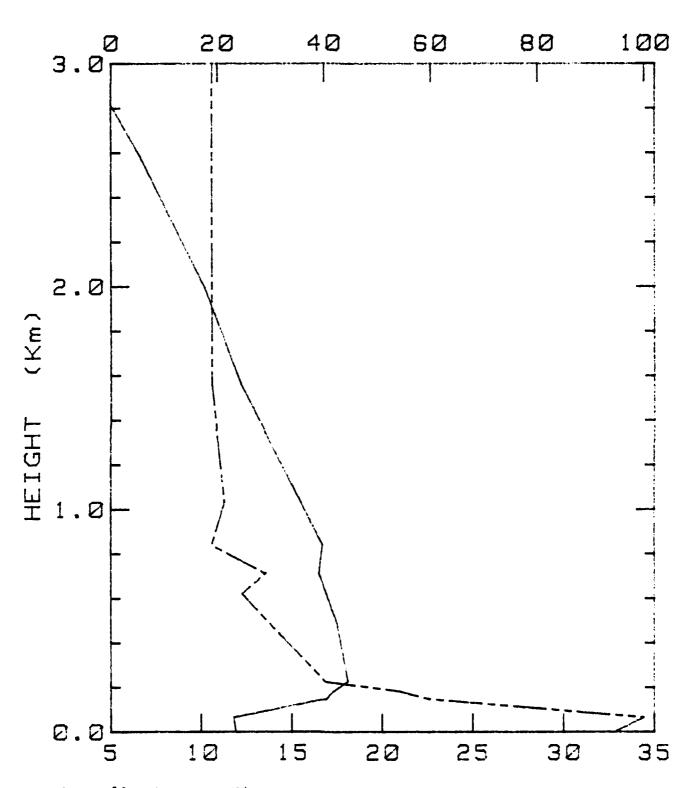


TEMP (CENT)

BLM-3 13 DEC 81 1520

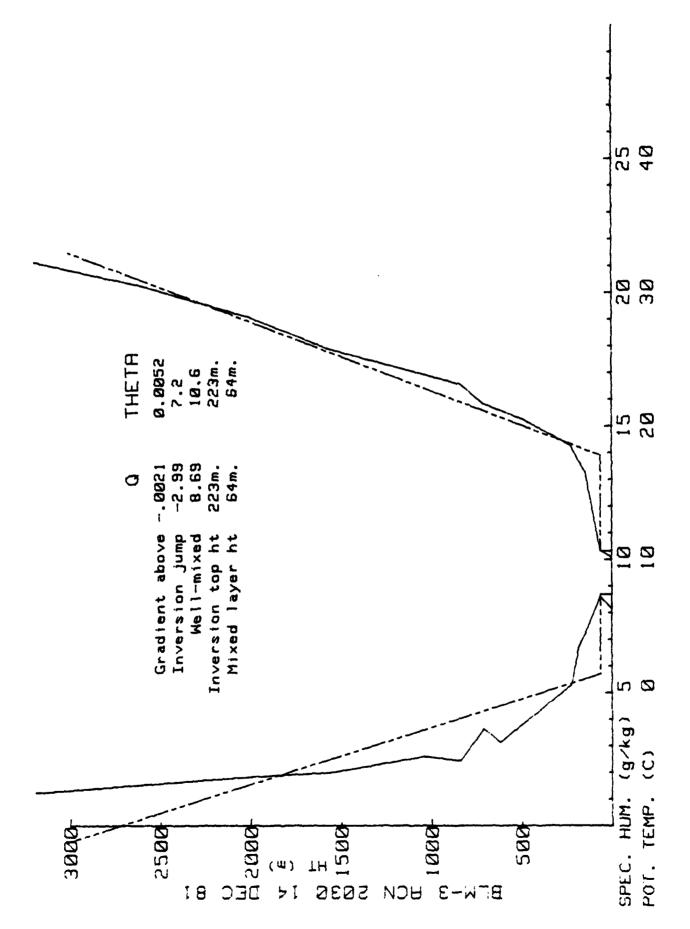


Migrate 12 b (5, 12 15,21)

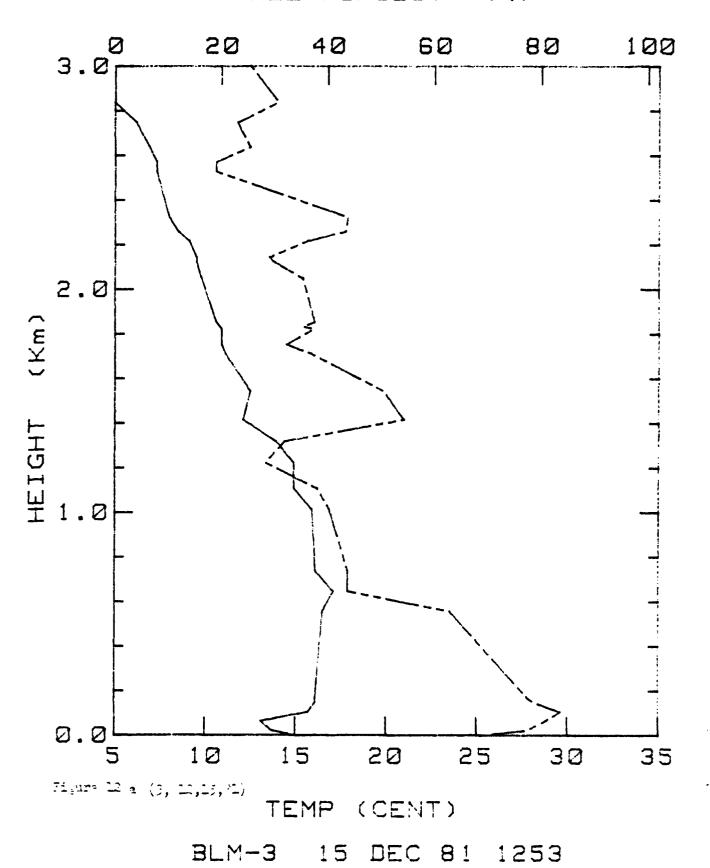


TEMP (CENT)

BLM-3 14 DEC 81 2030



FI. (11) (3, 13,14, 1)



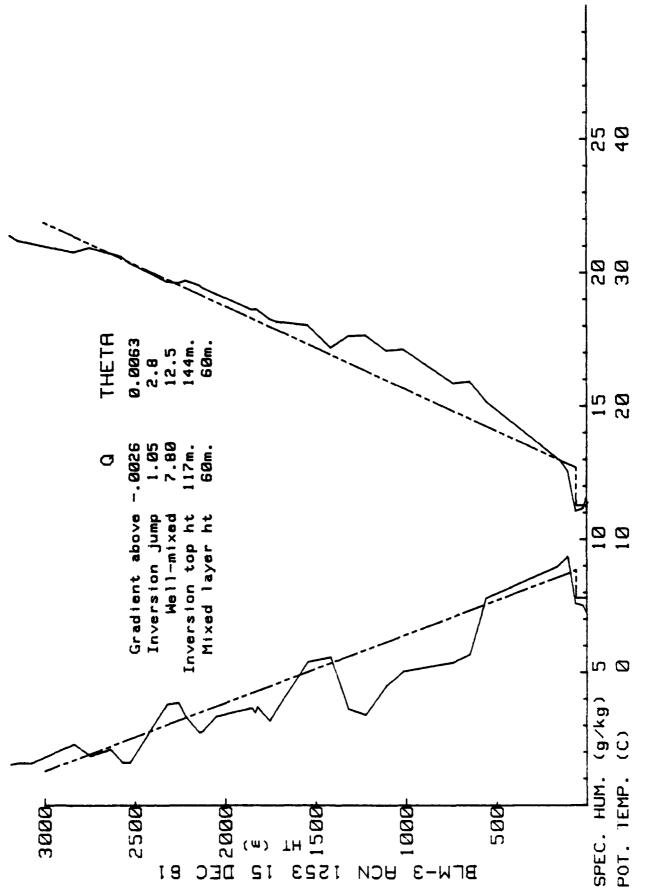
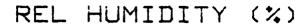
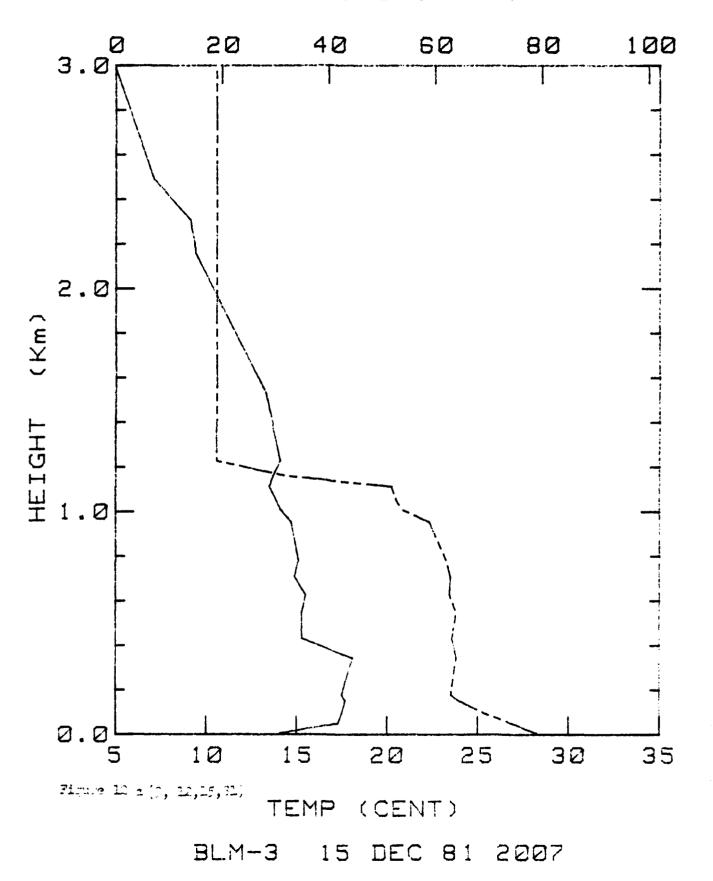


Figure 12 b (3, 12,15,21)





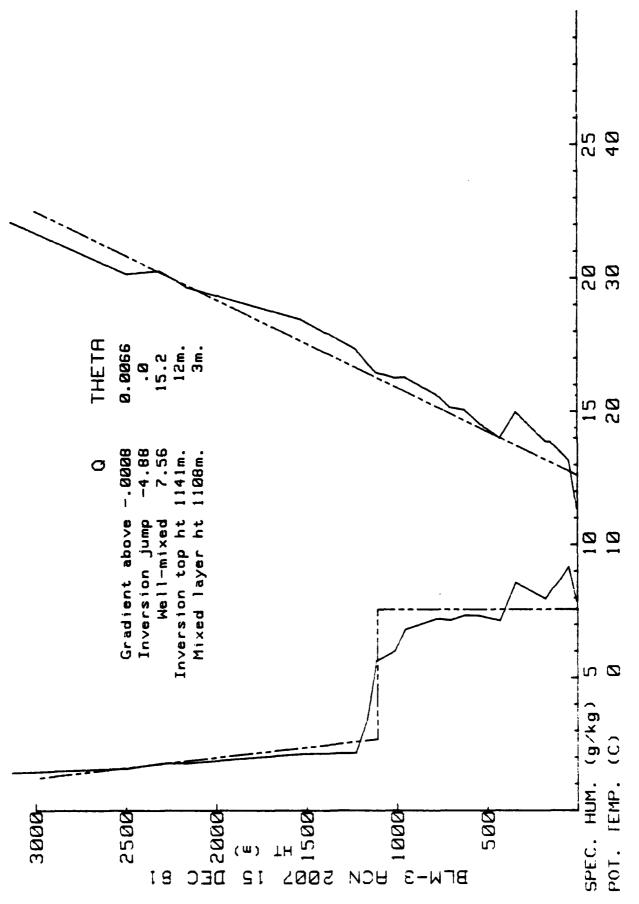
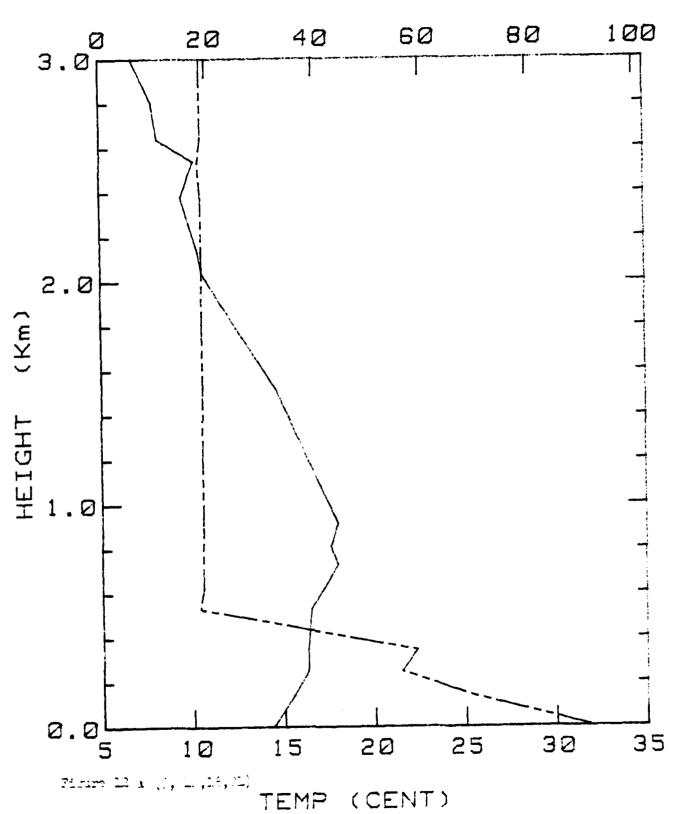
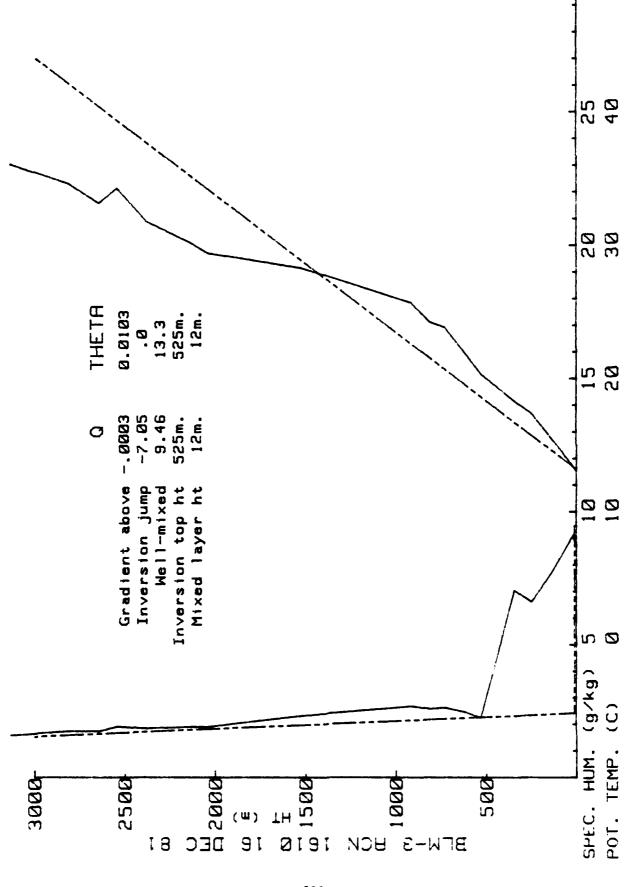


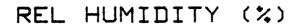
Figure 1. b ( , 1., 1., 1.)

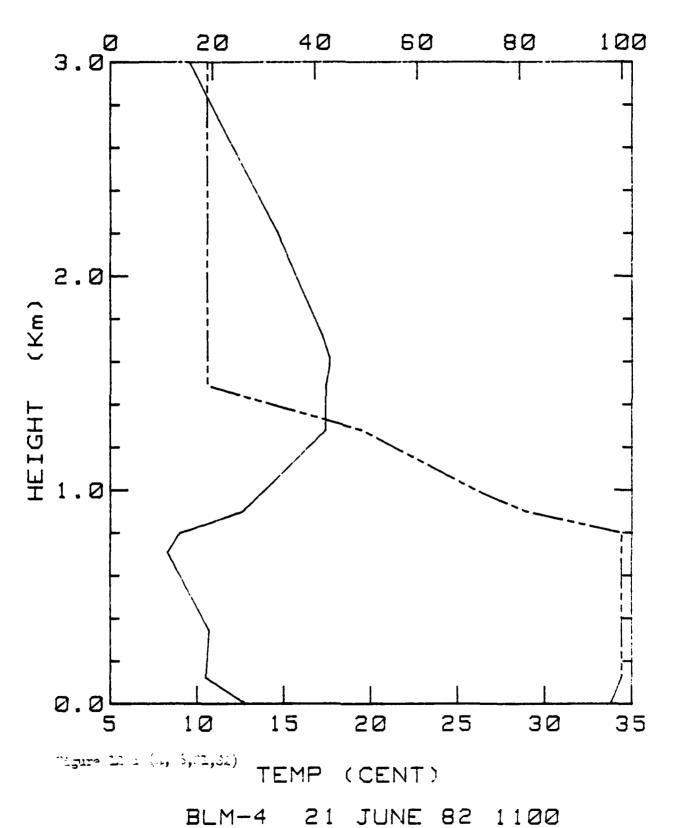


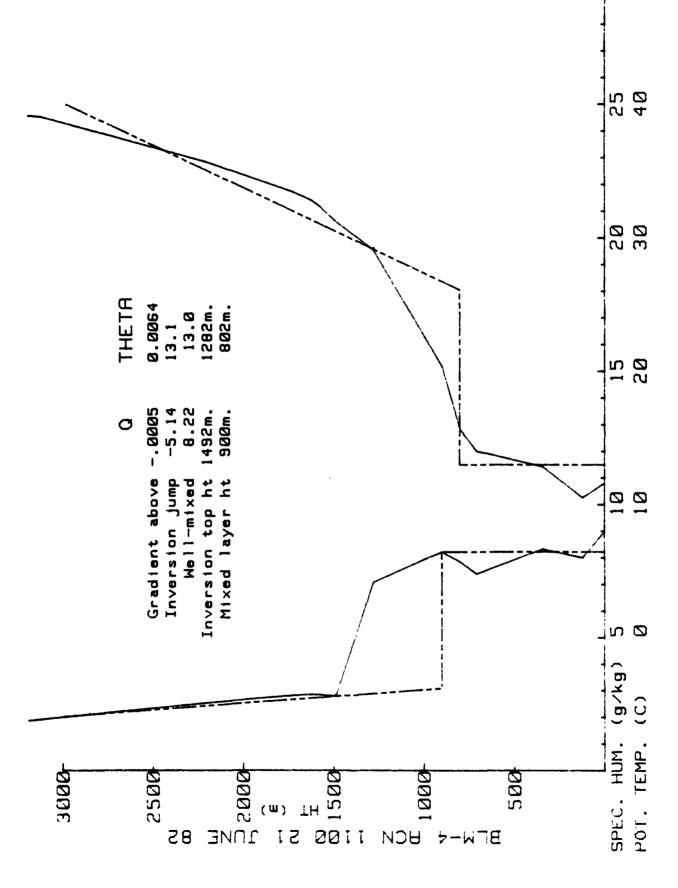
BLM-3 16 DEC 81 1610



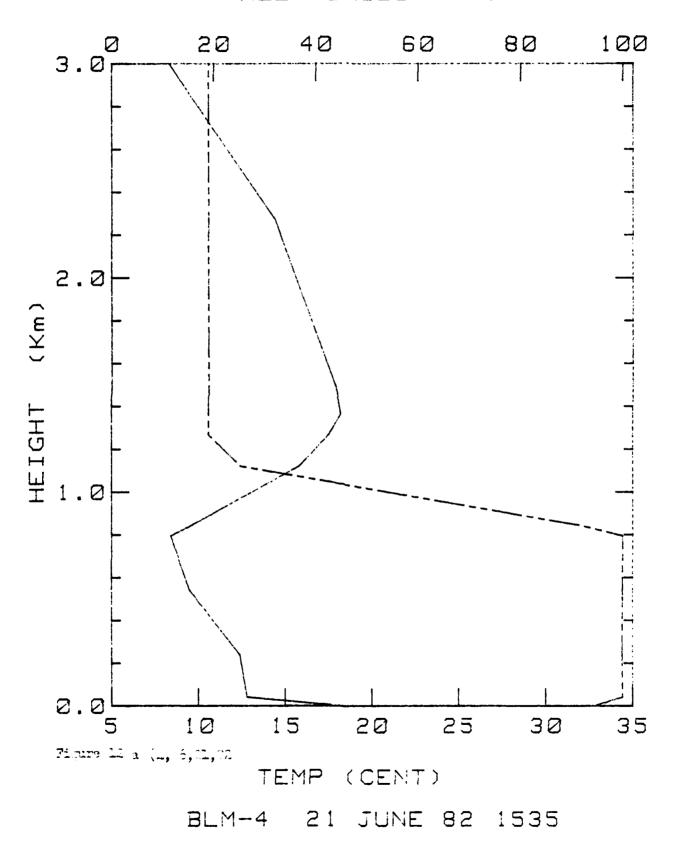
ri, one 12 b (5, 10,56,20)

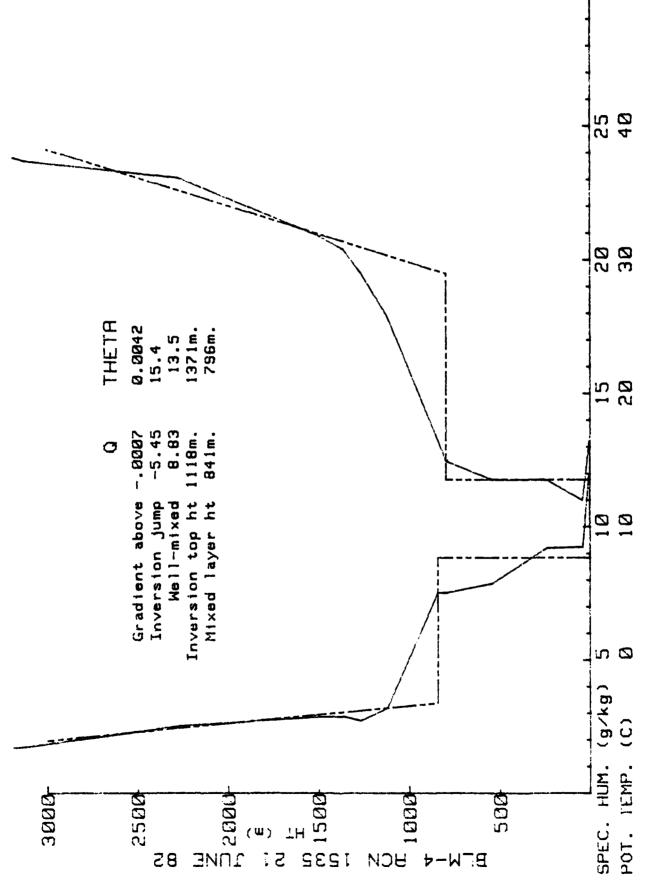




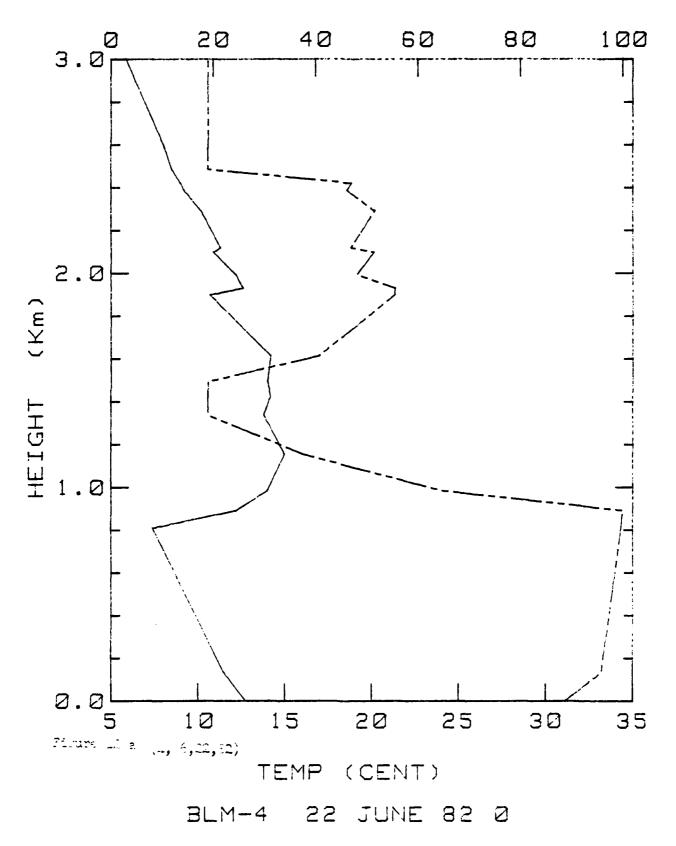


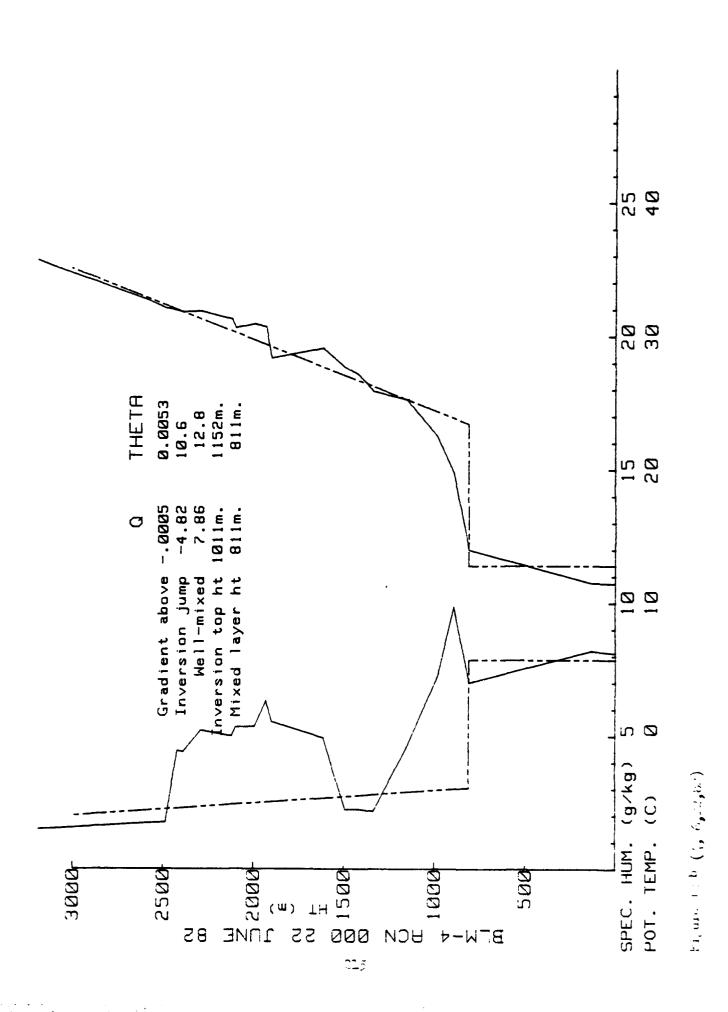
1 me 1 to (4, 6,01,52)





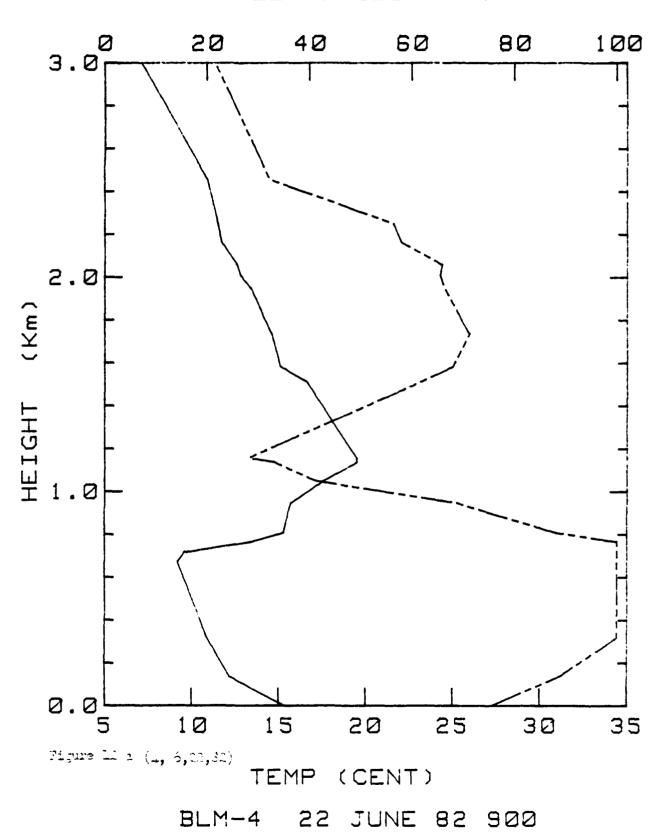
 $d_{\rm cons} \approx b \; (s, \zeta, \eta, c)$ 

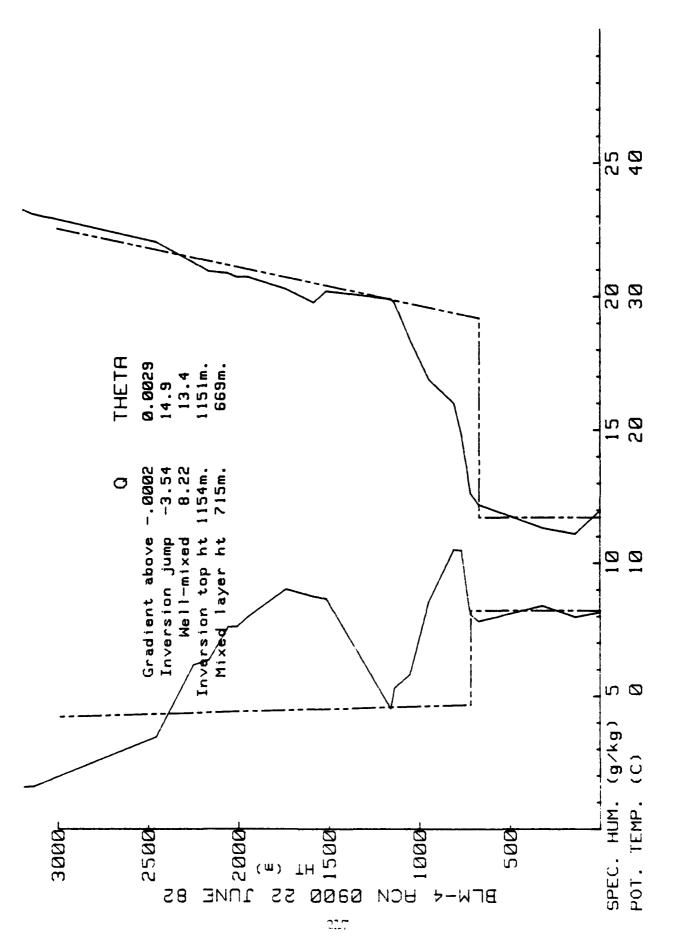




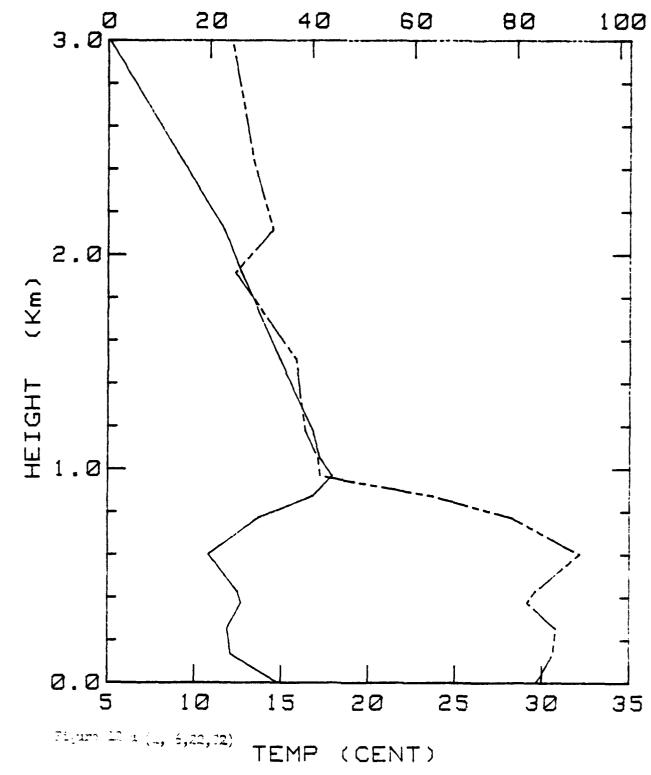
The state of the s

The society of the second of the second

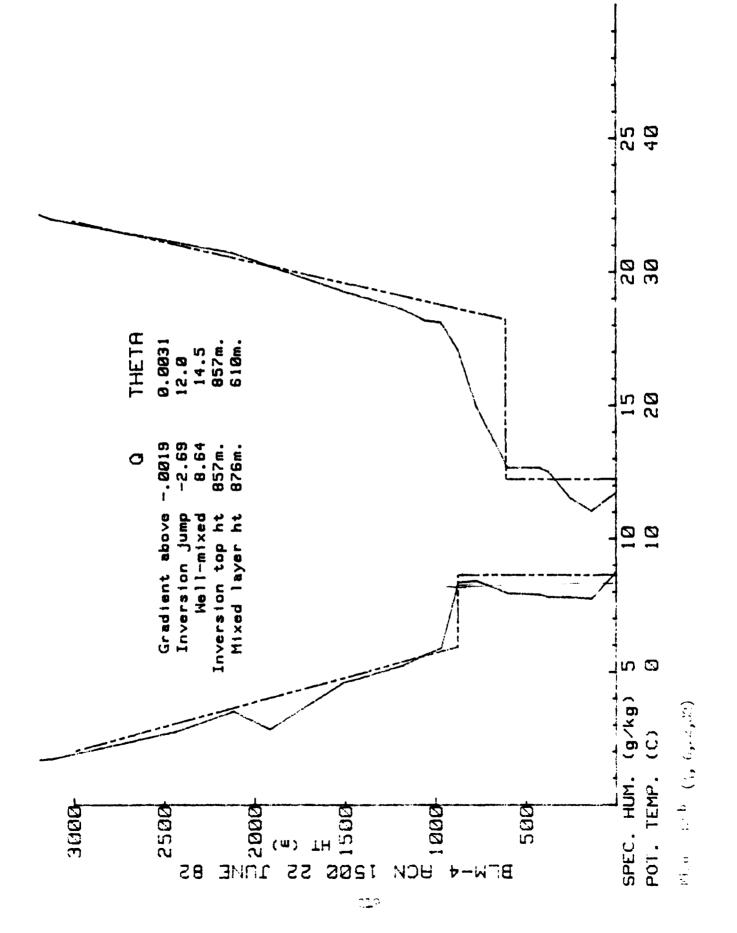




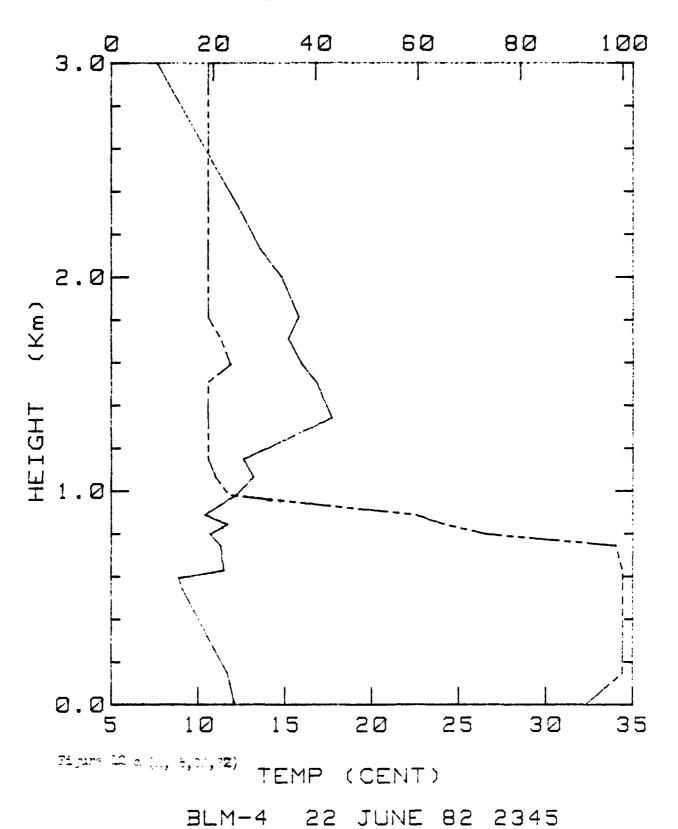
(1) (1) (1) (2) (2)

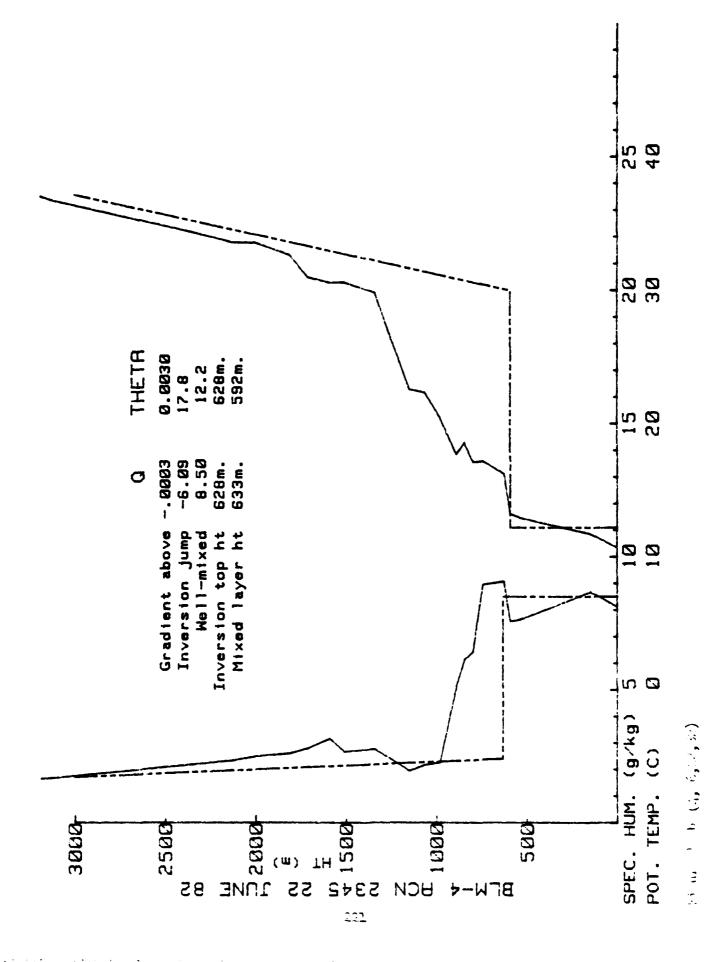


BLM-4 22 JUNE 82 1500

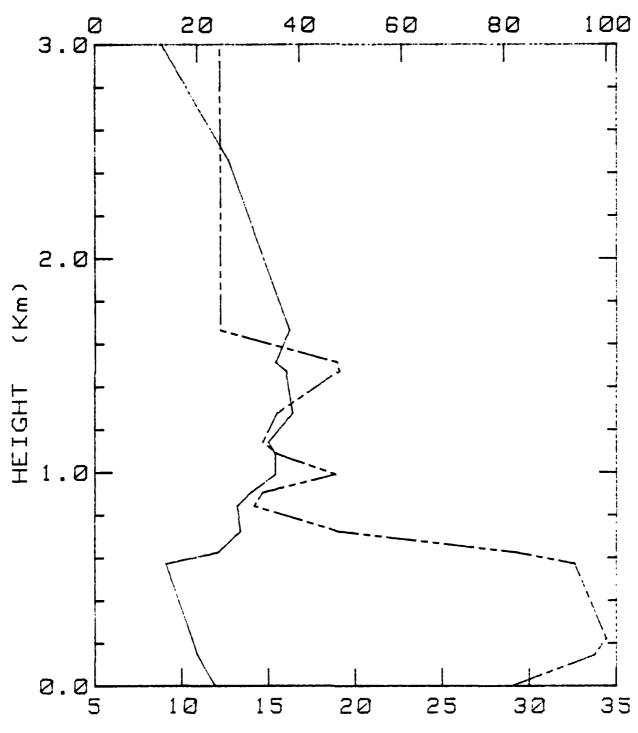






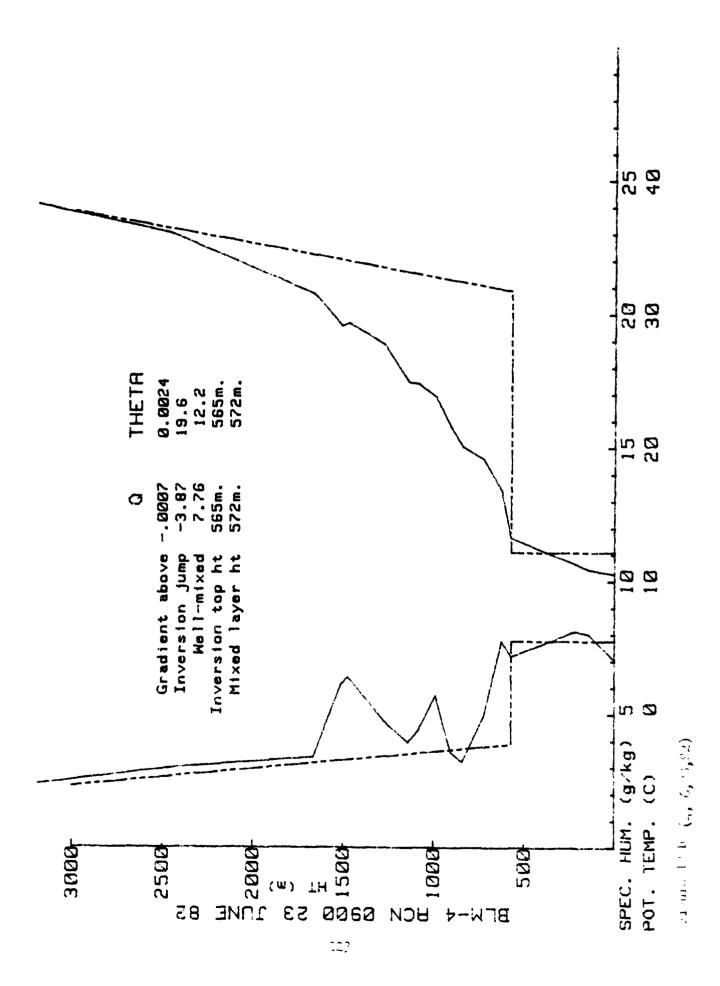


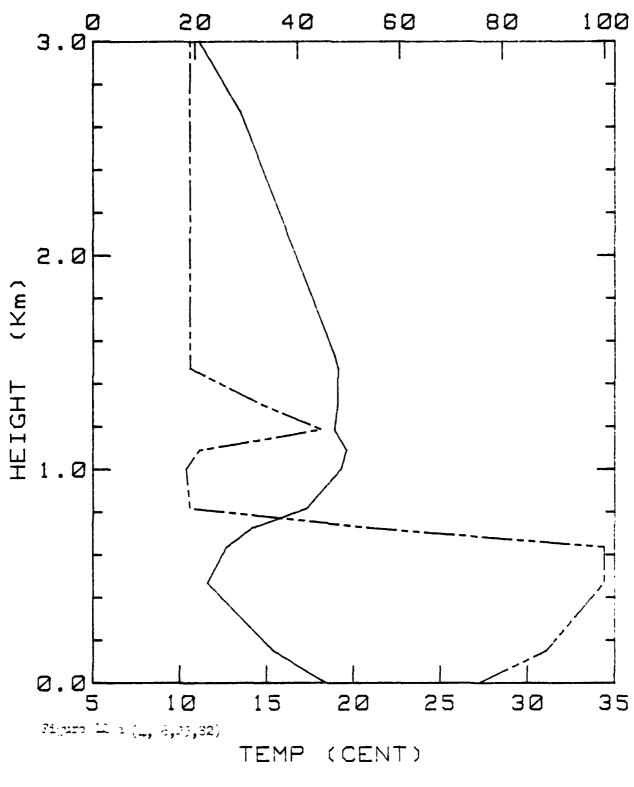
Z



75 yuro 12 a (4, 6,20,32) TEMP (CENT)

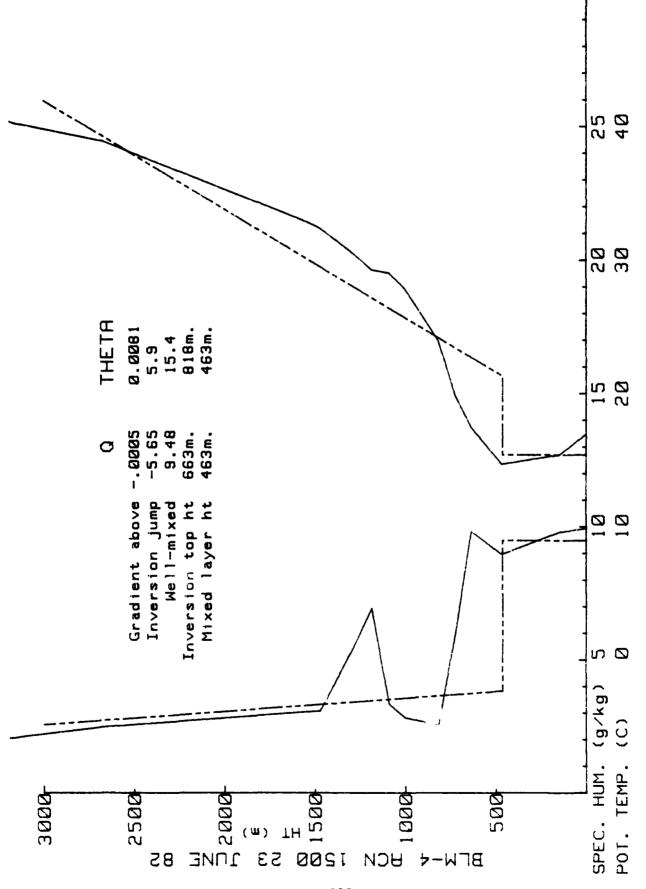
BLM-4 23 JUNE 82 900



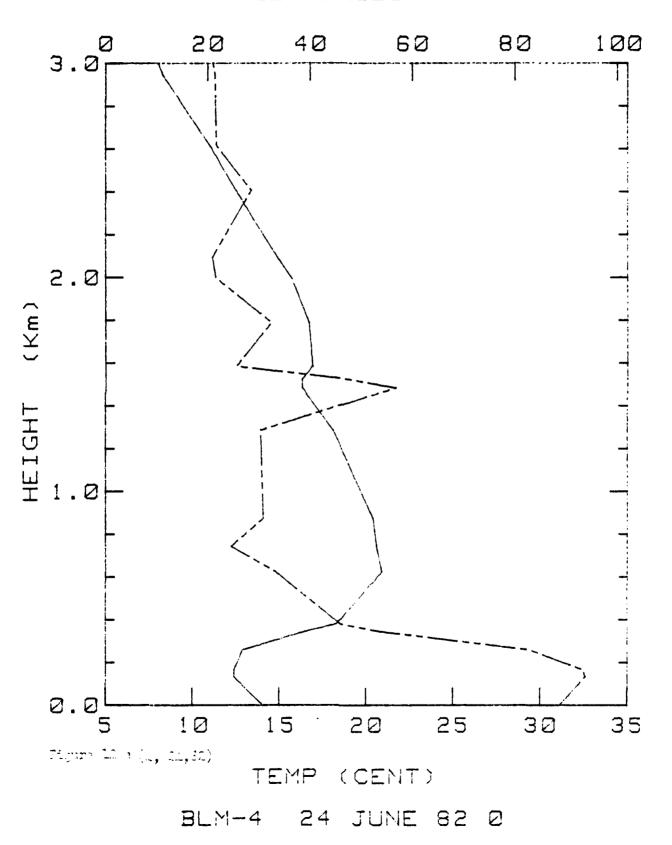


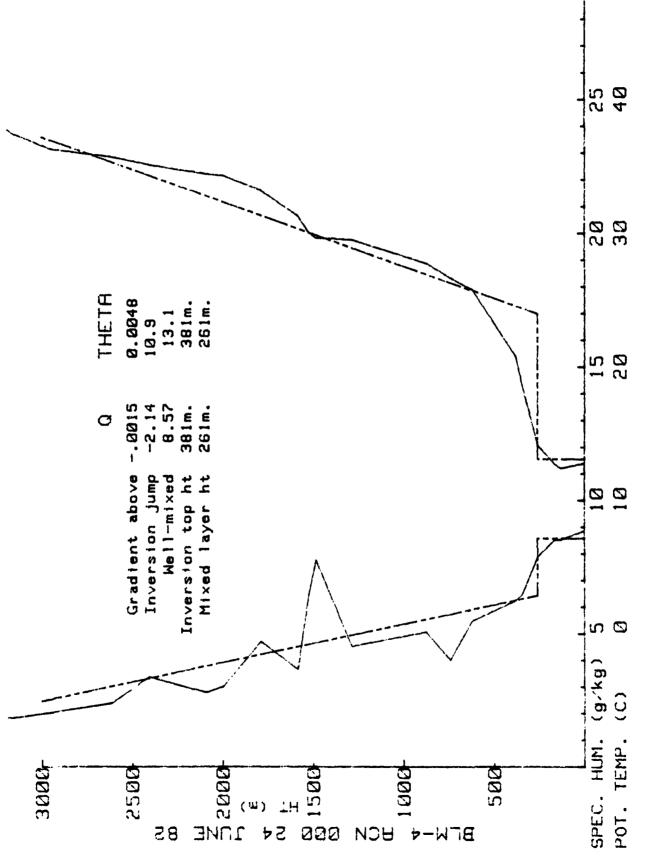
BLM-4 23 JUNE 82 1500

. -. ----

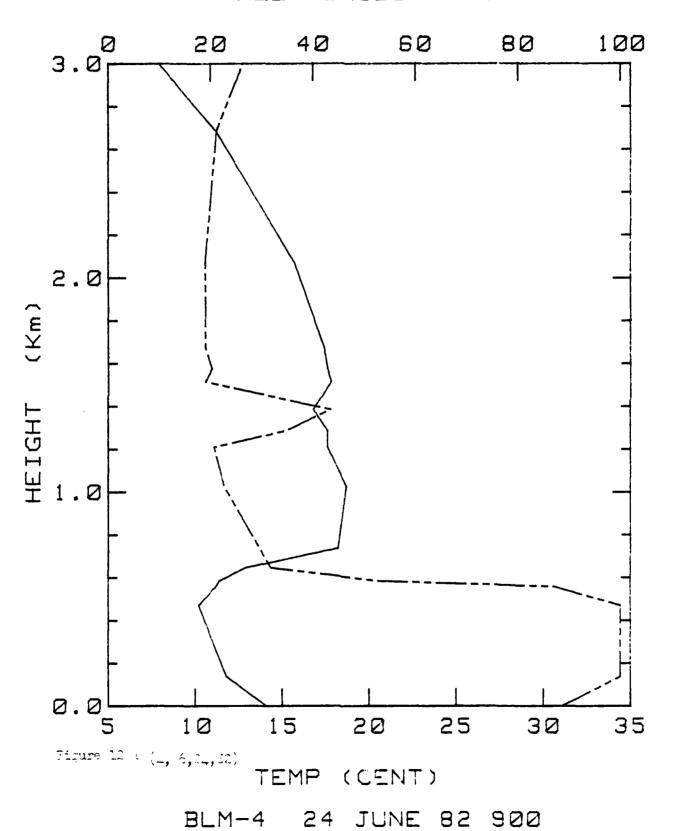


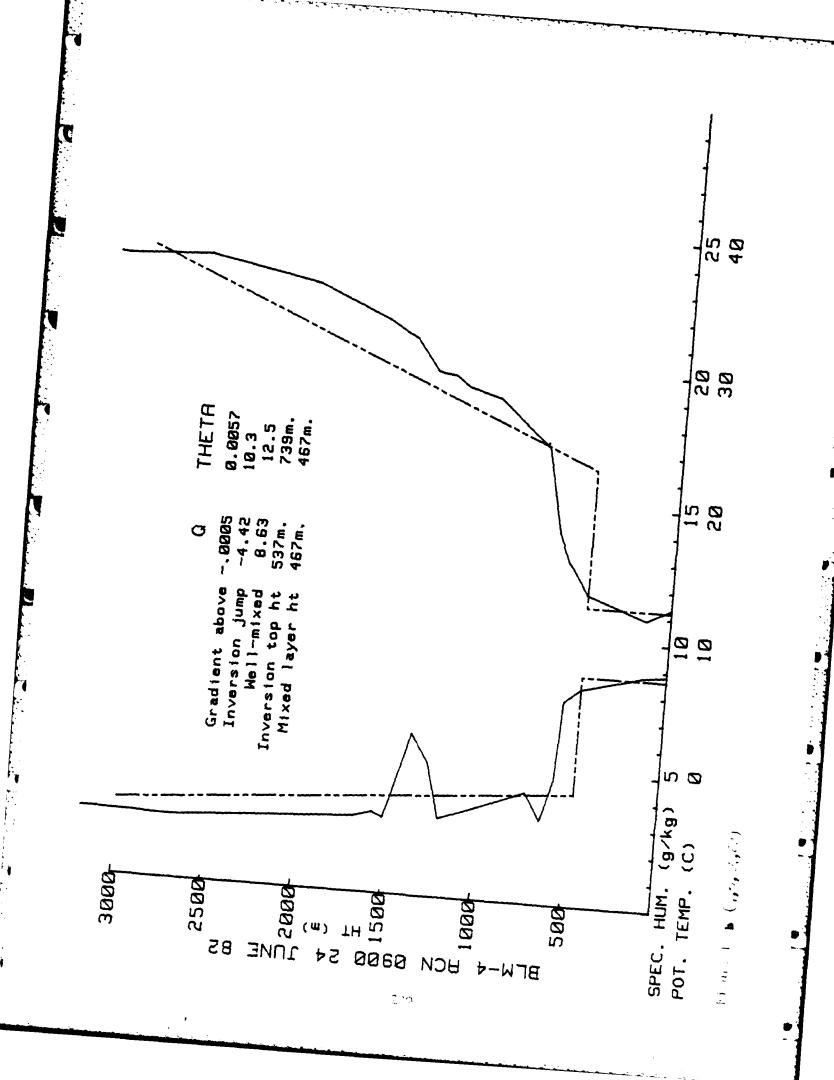
Mount of the (4, 6, 15, 2)

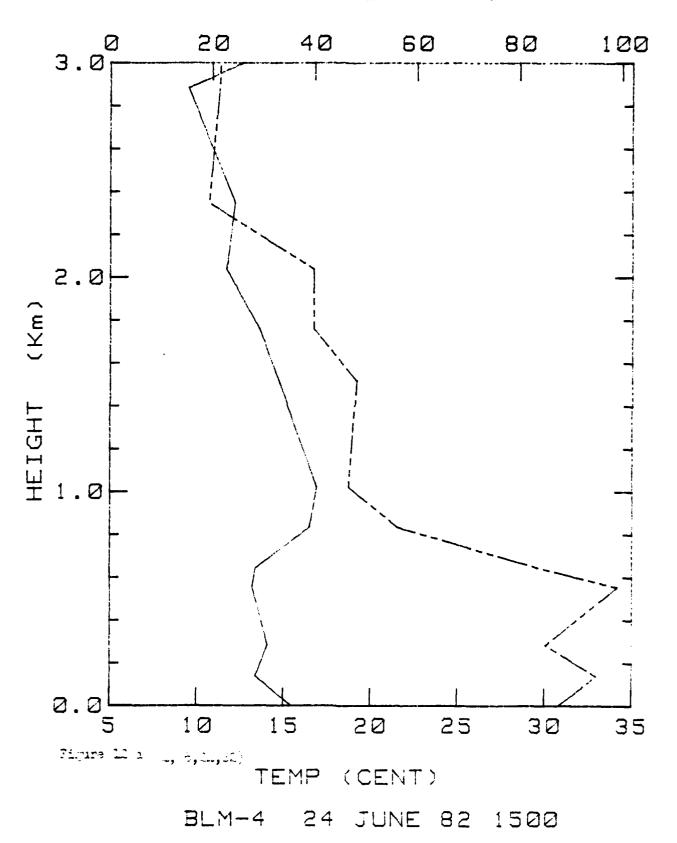


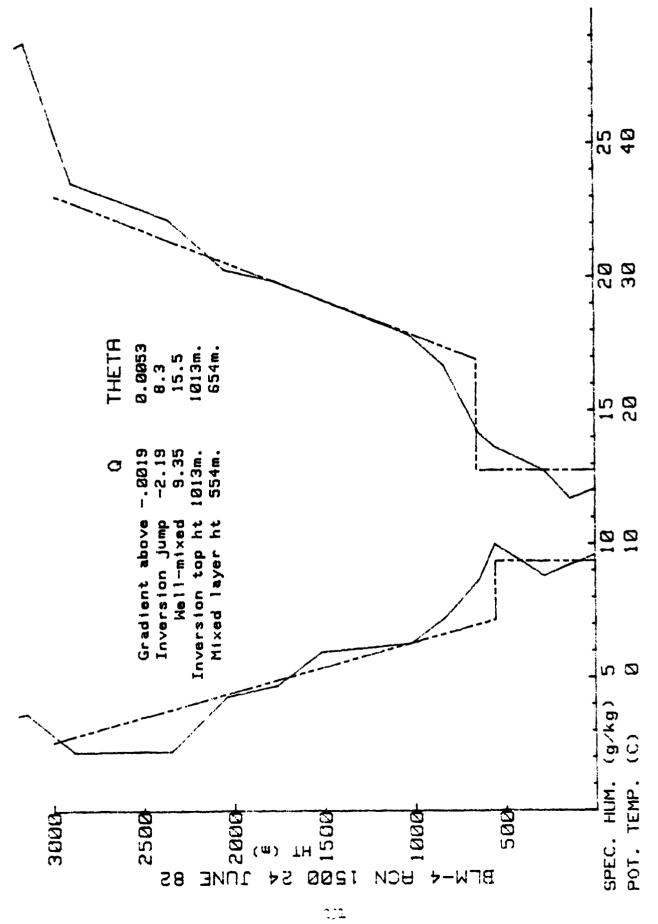


31,000 to b (c), (,24,82)

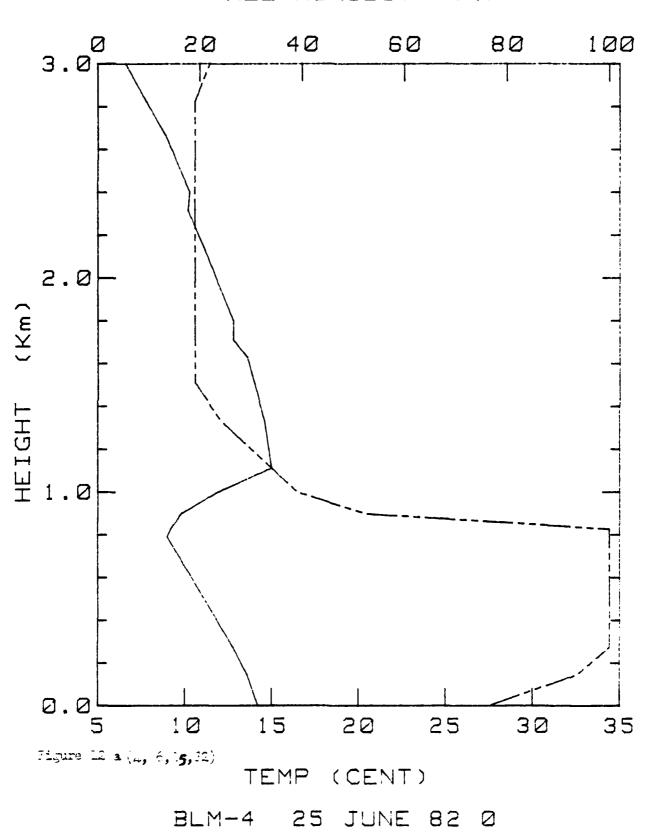


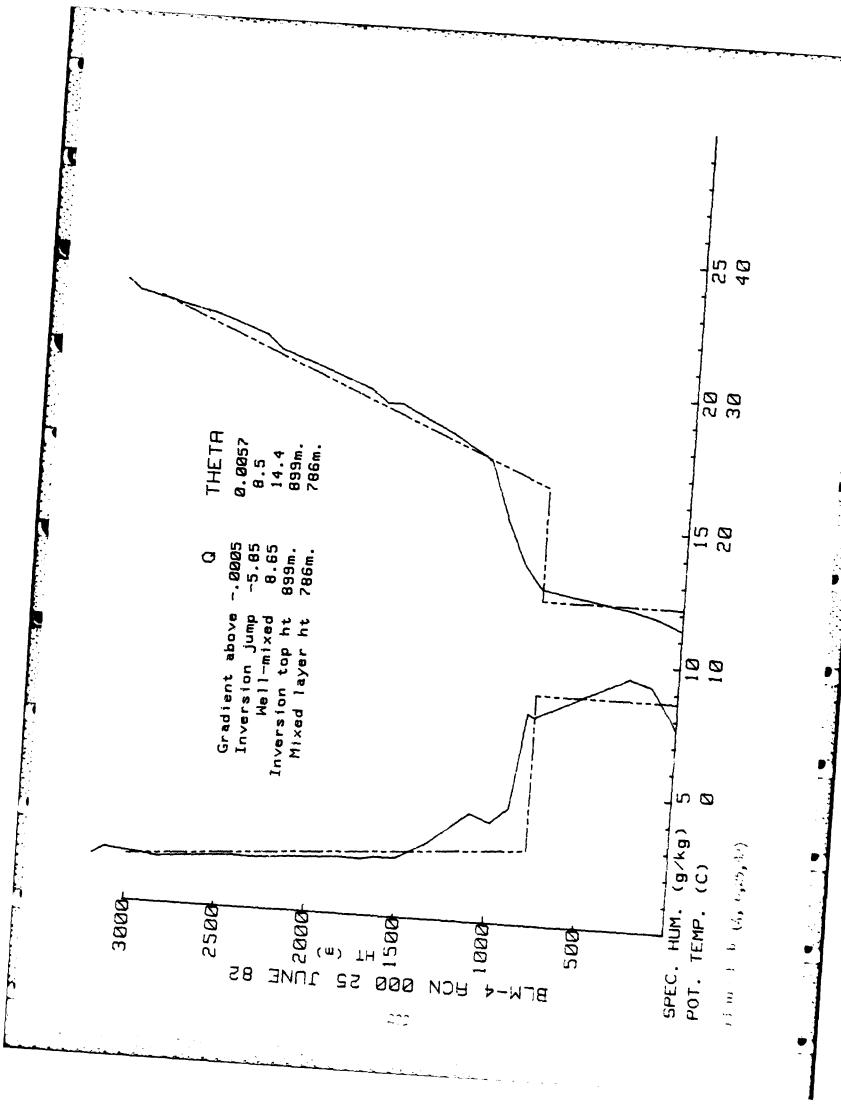


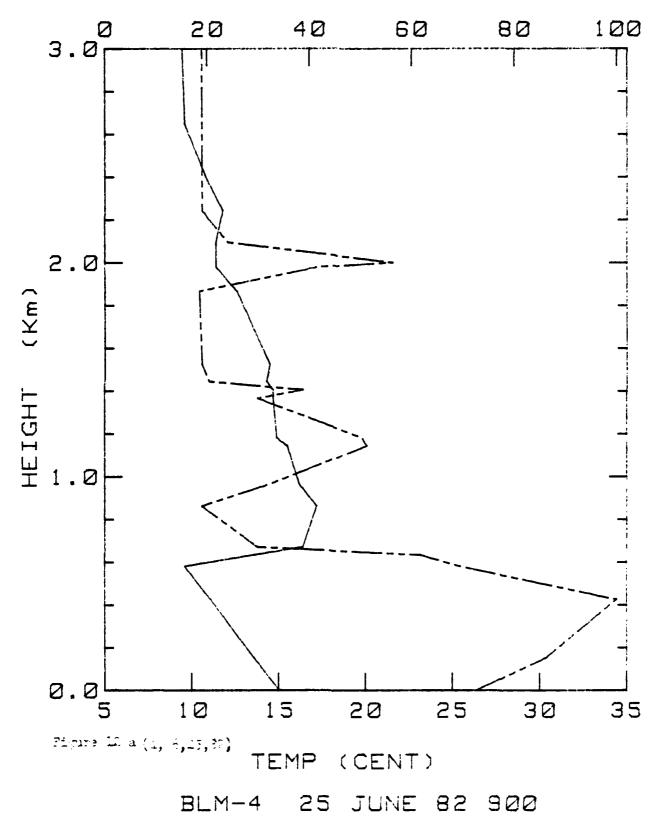


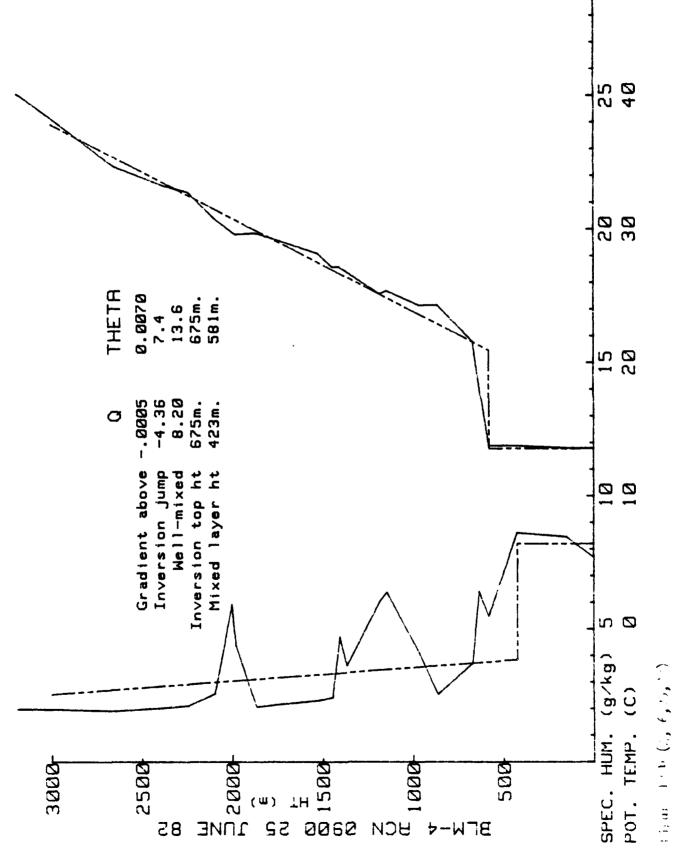


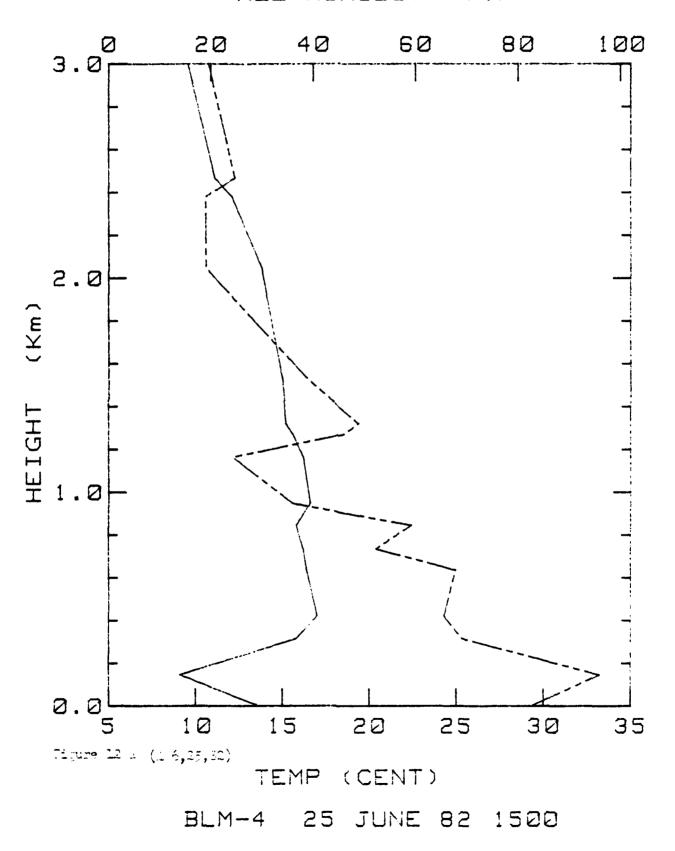
( is an a L ( C , C , S , d , d )

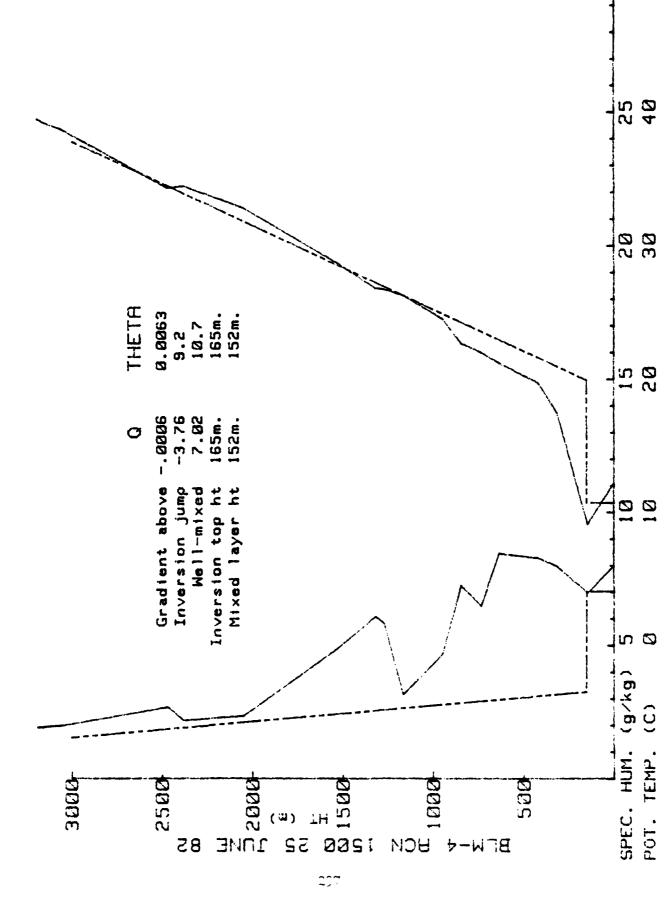




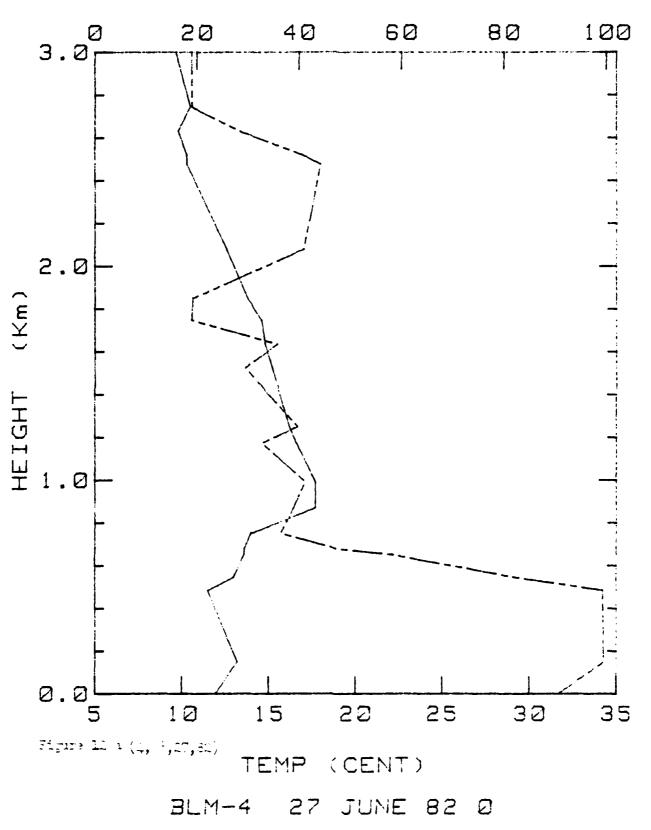


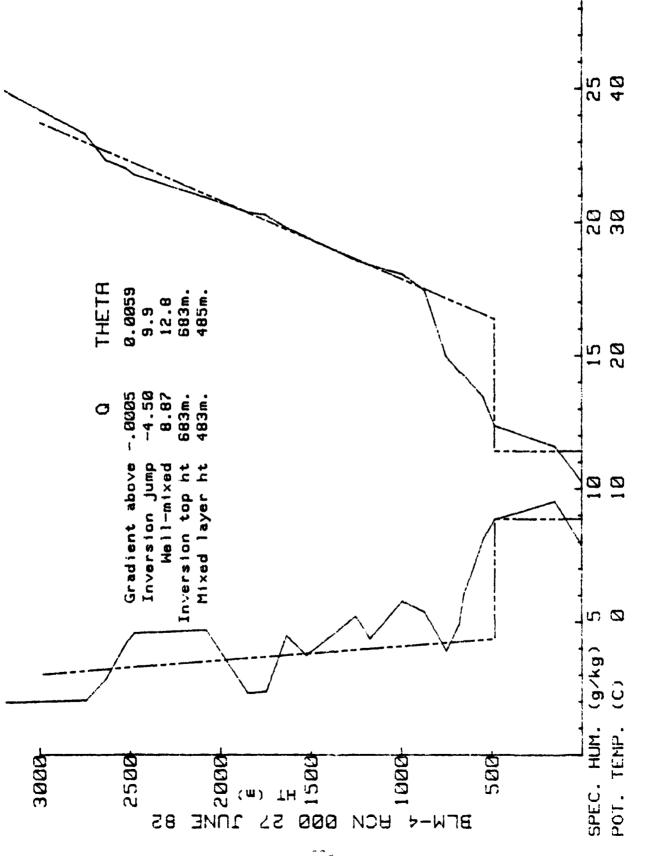




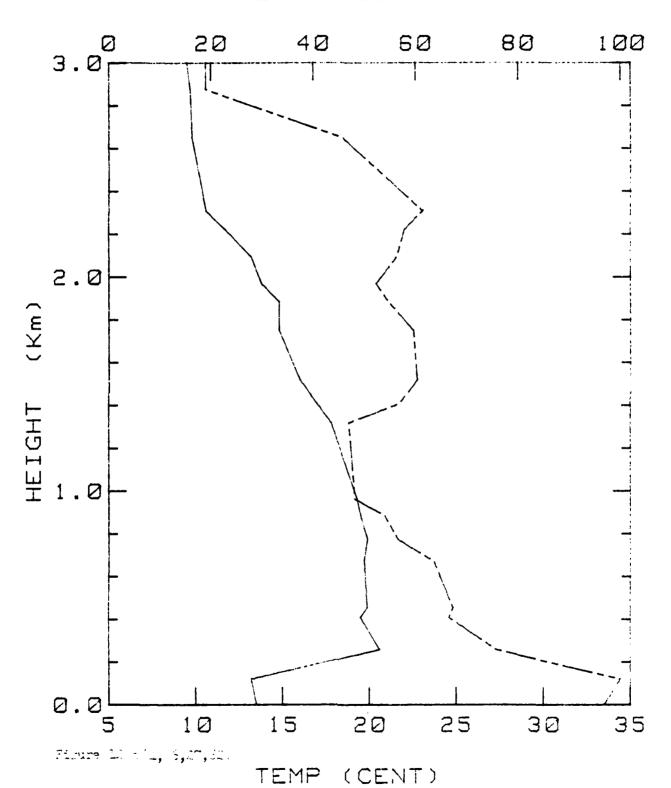


(1. 6, 19, 6, 19, 64)

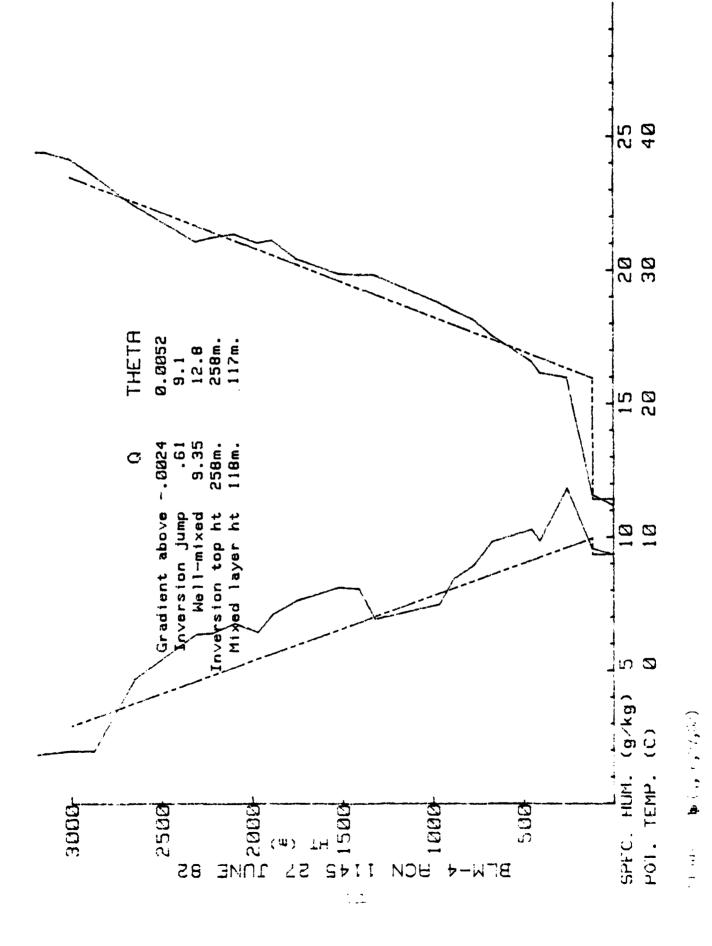


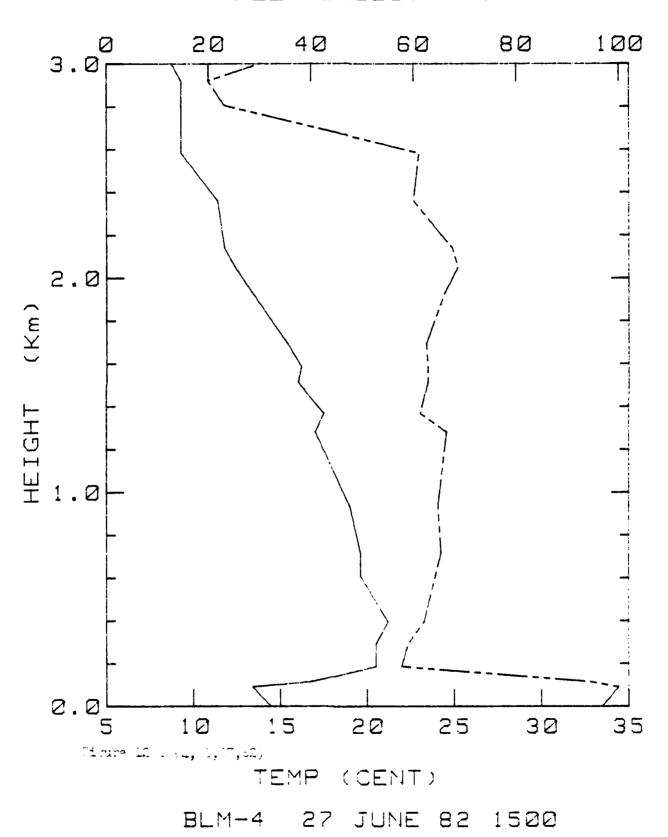


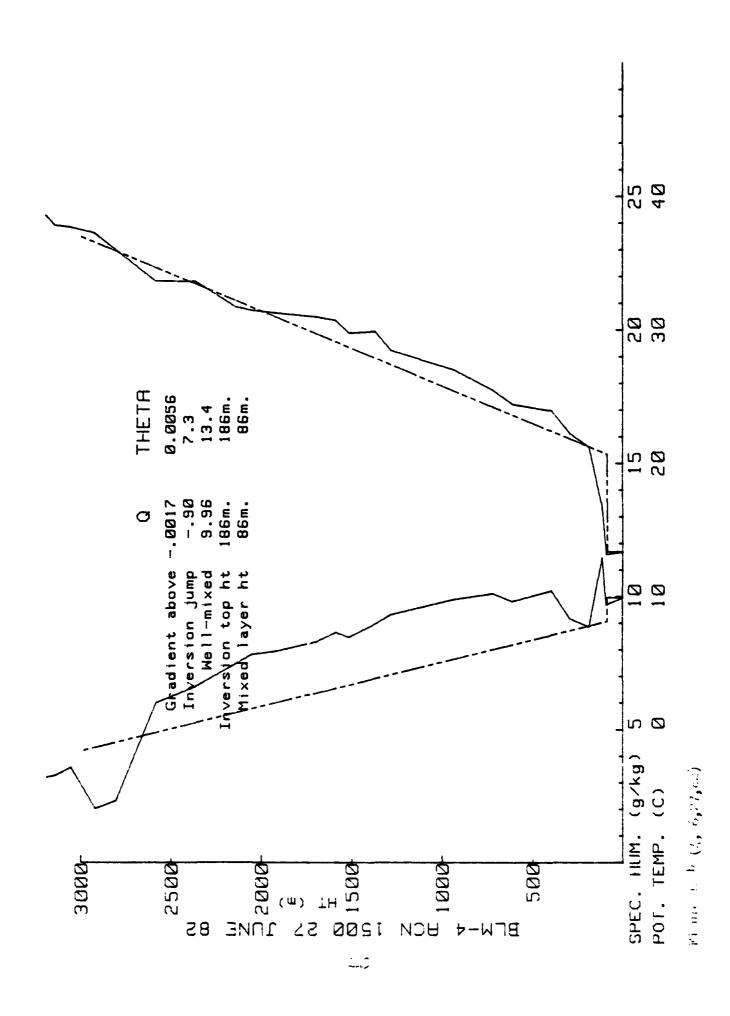
El ar 1, b (4, 6,77,33)

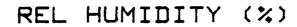


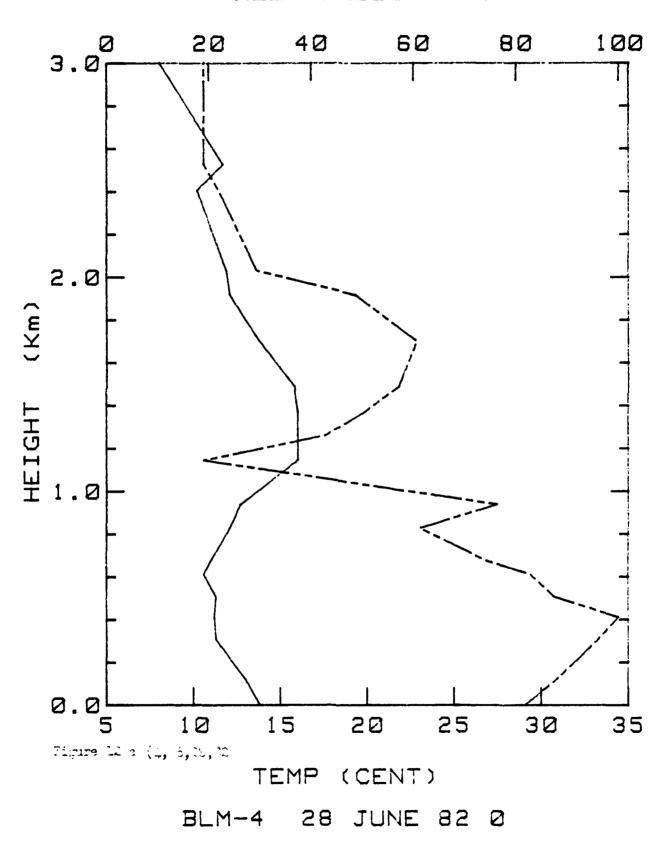
BLM-4 27 JUNE 82 1145











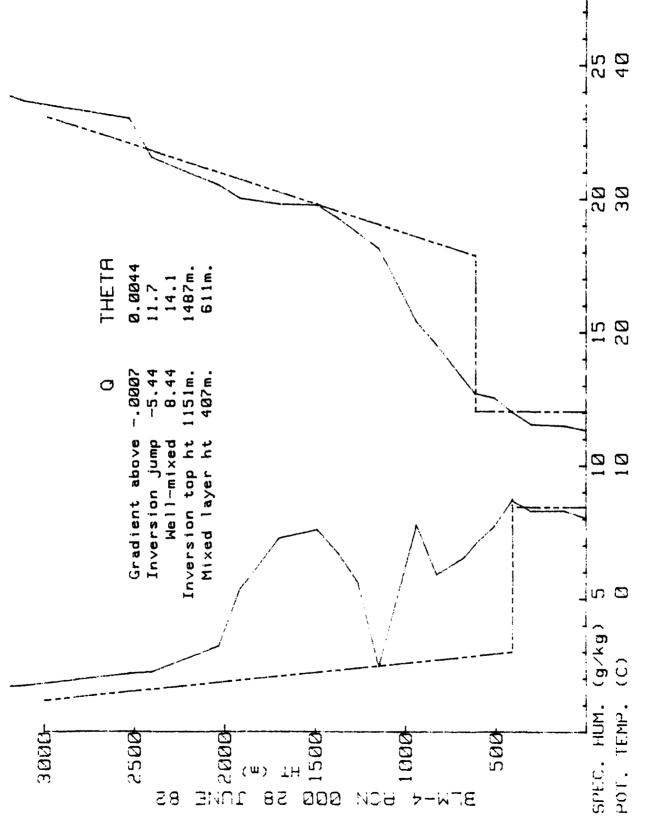
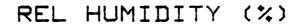
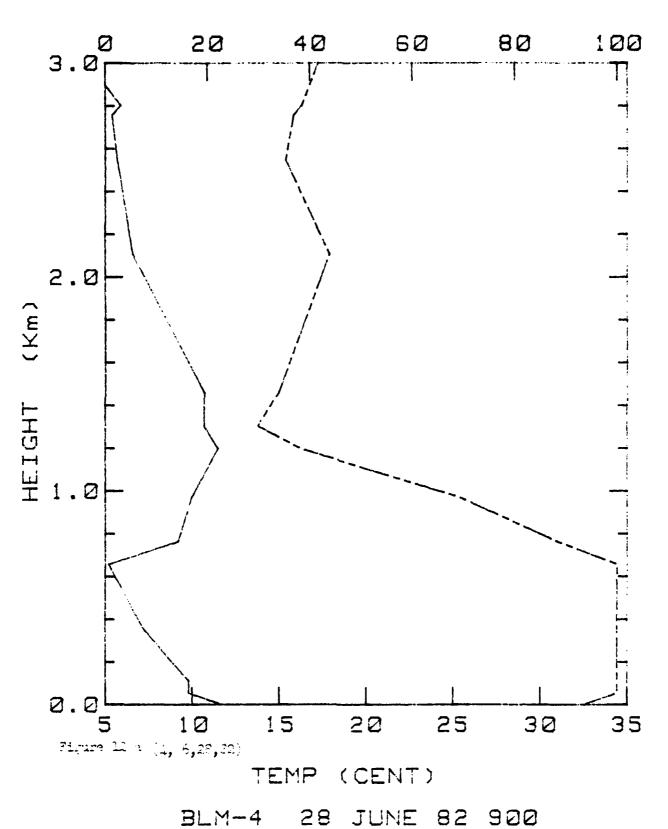
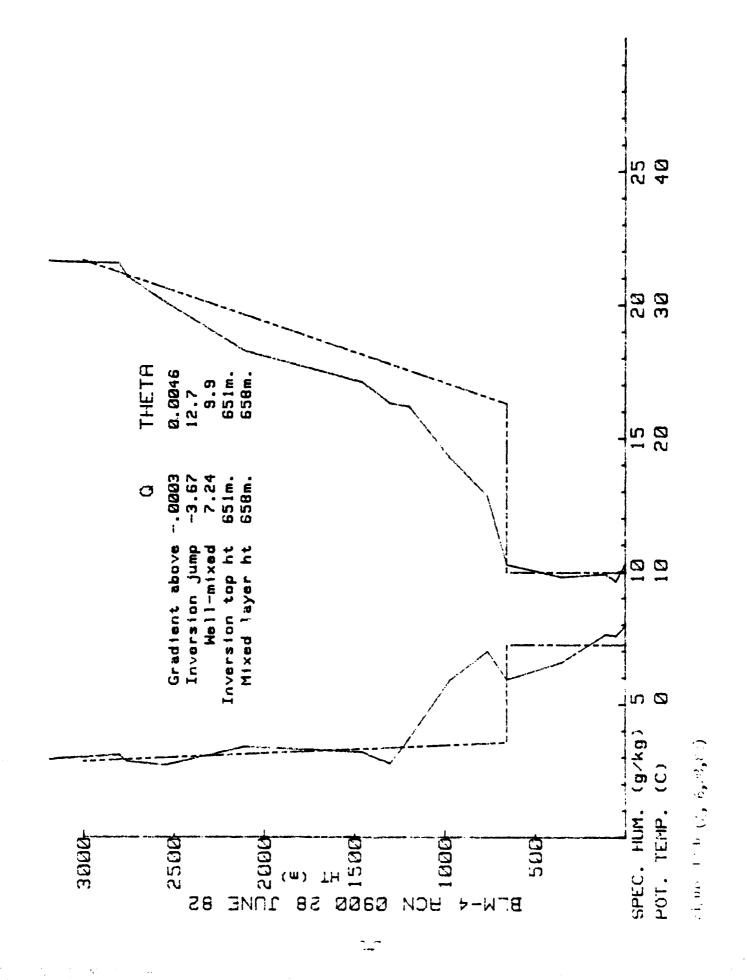
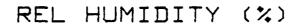


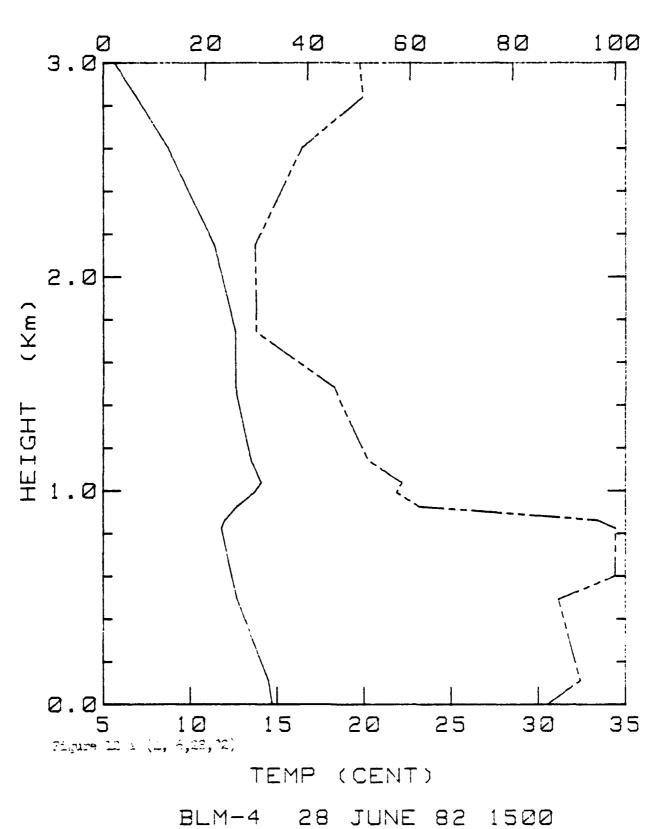
Figure 1: b (4, 6,23,8.)

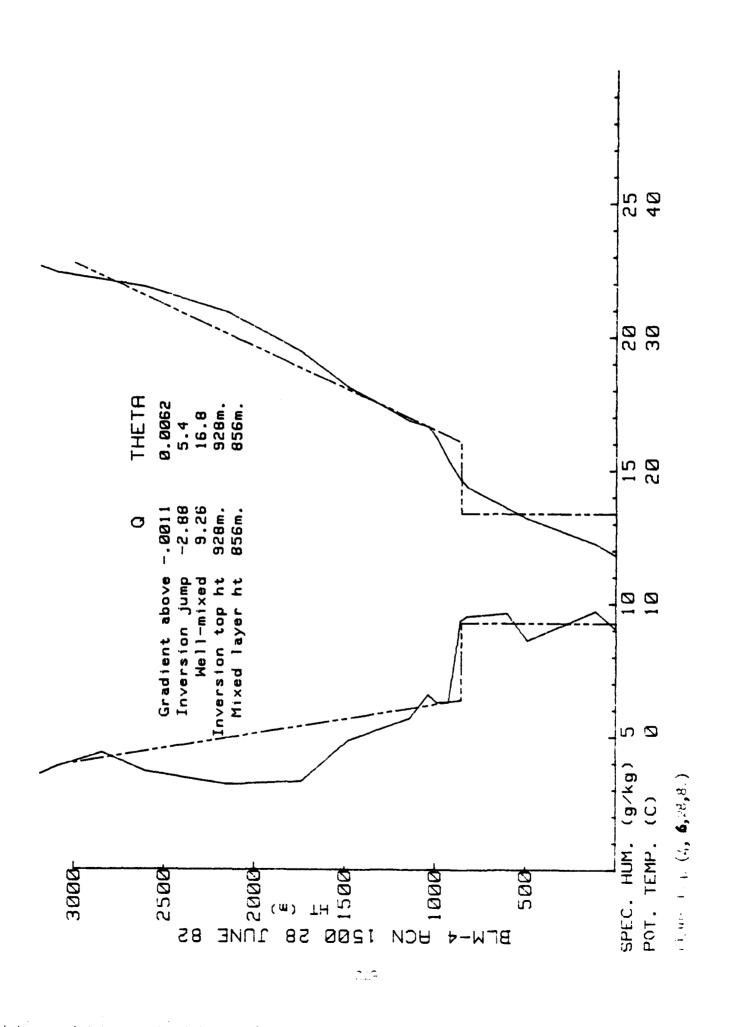


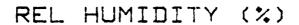


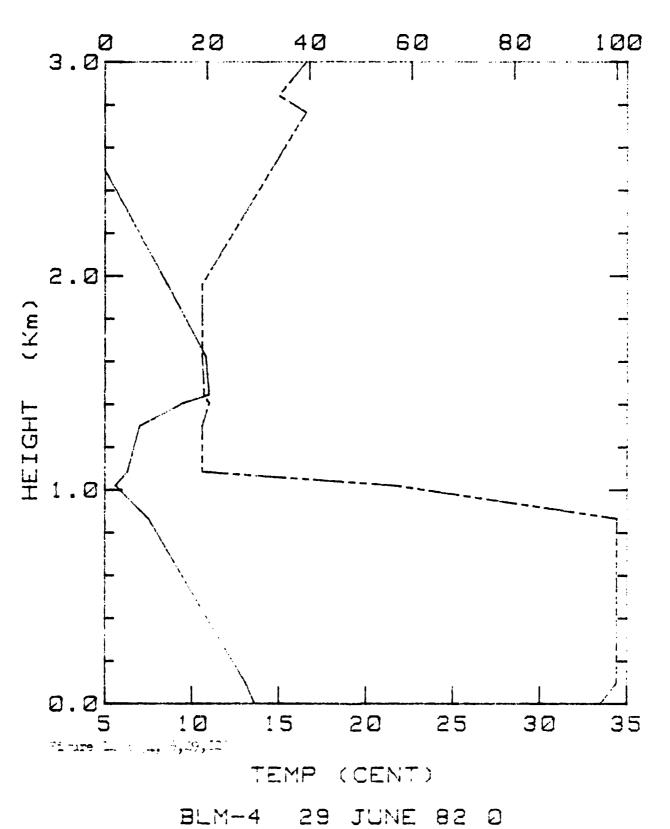


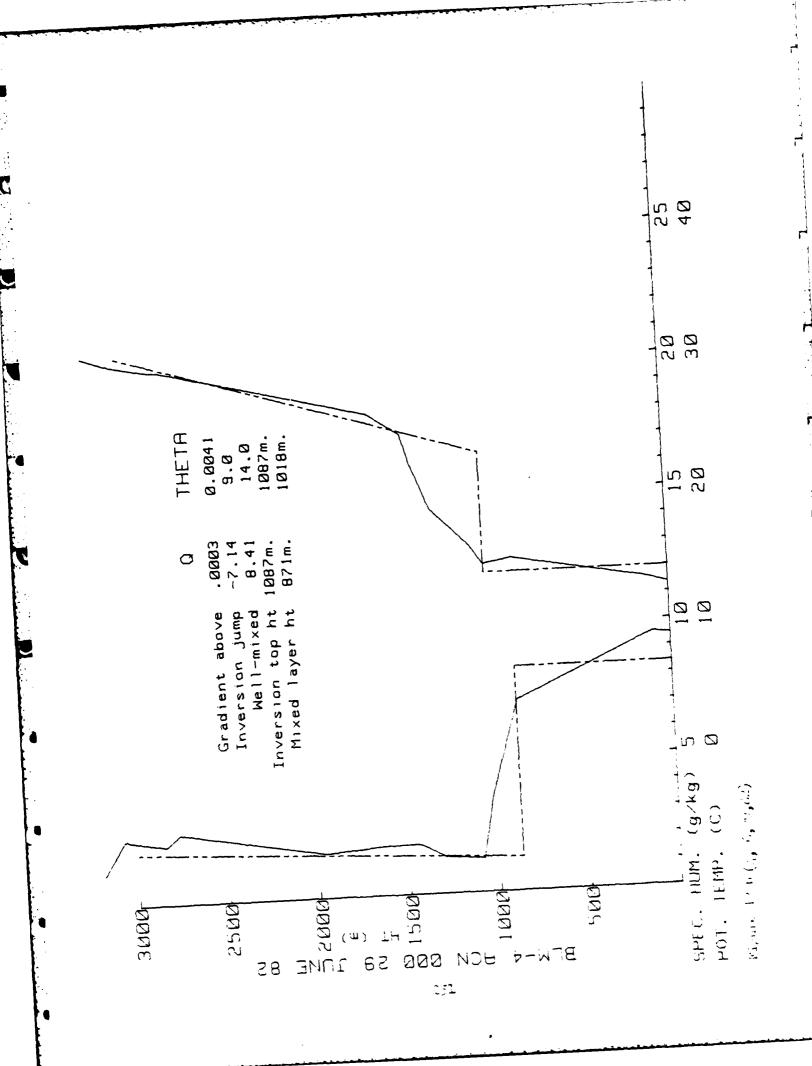


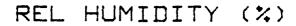


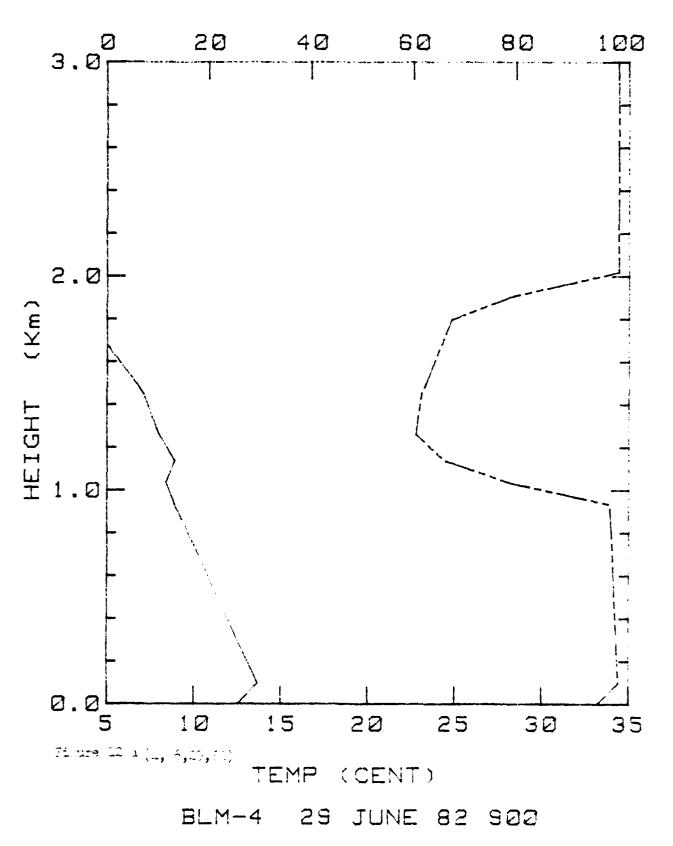


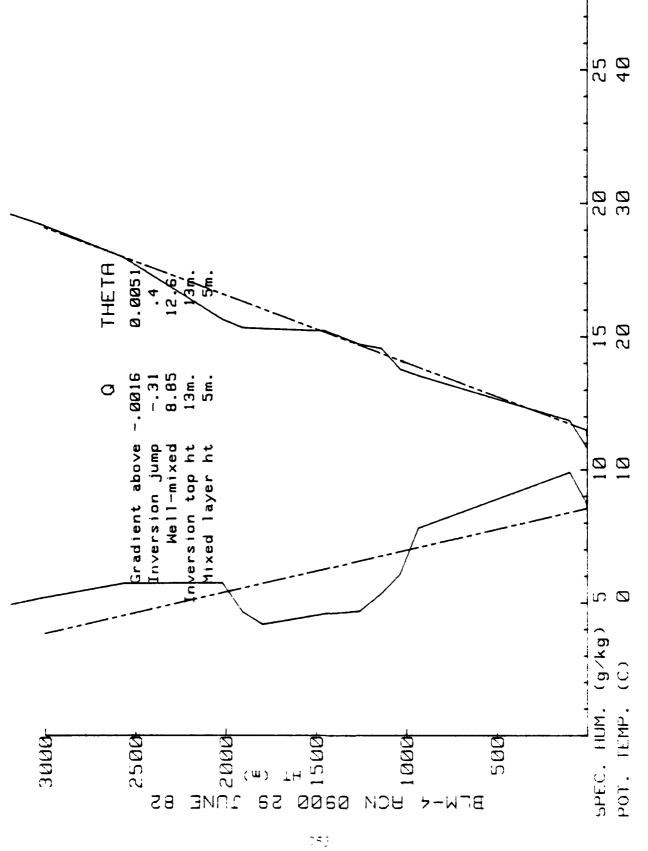




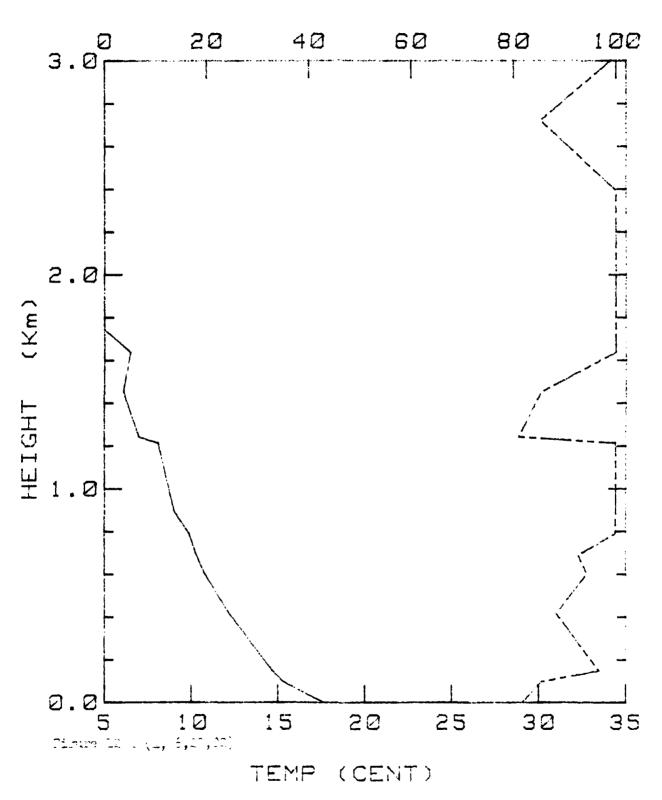




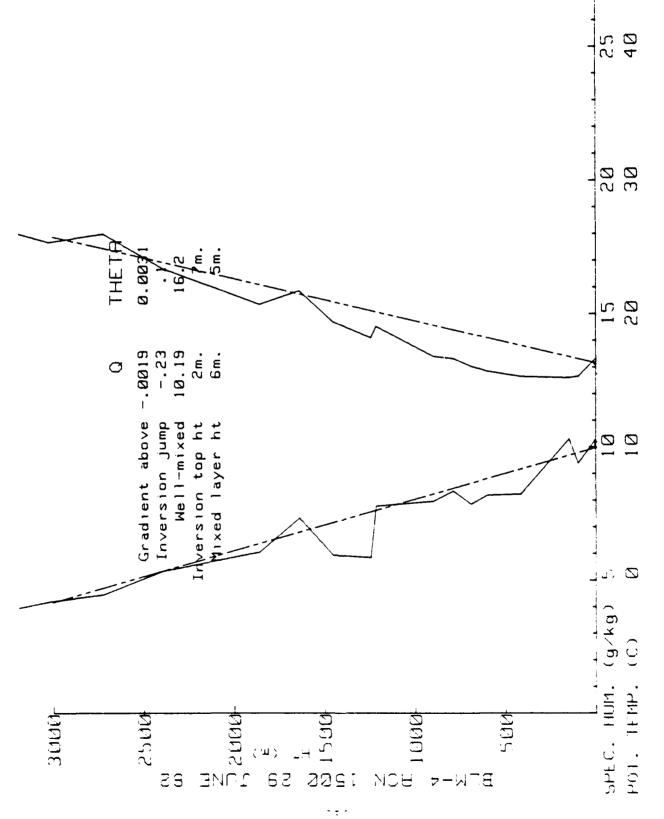


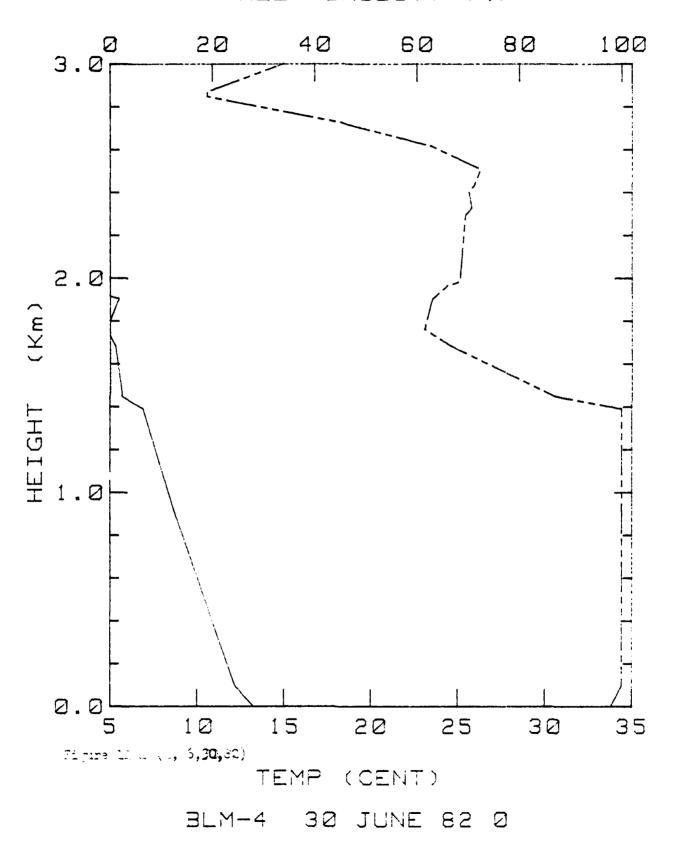


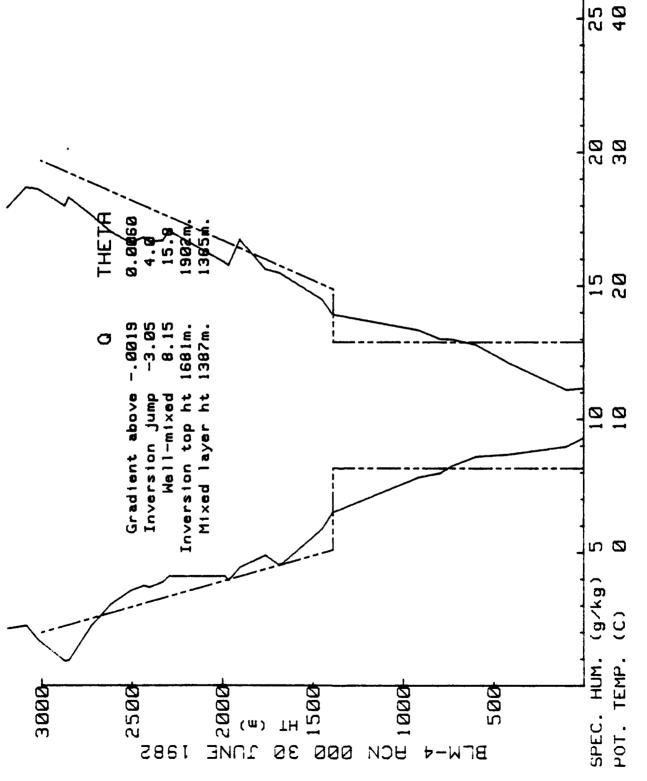
elimical bar (in bylogal)



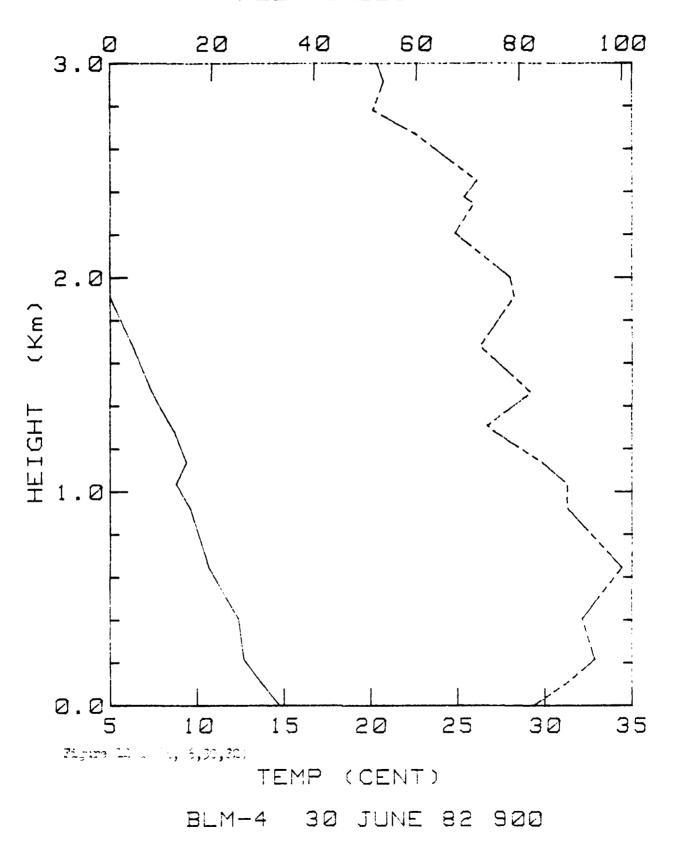
BLM-4 29 JUNE 82 1500







13 m 10 b (2, 6, 30, 3)



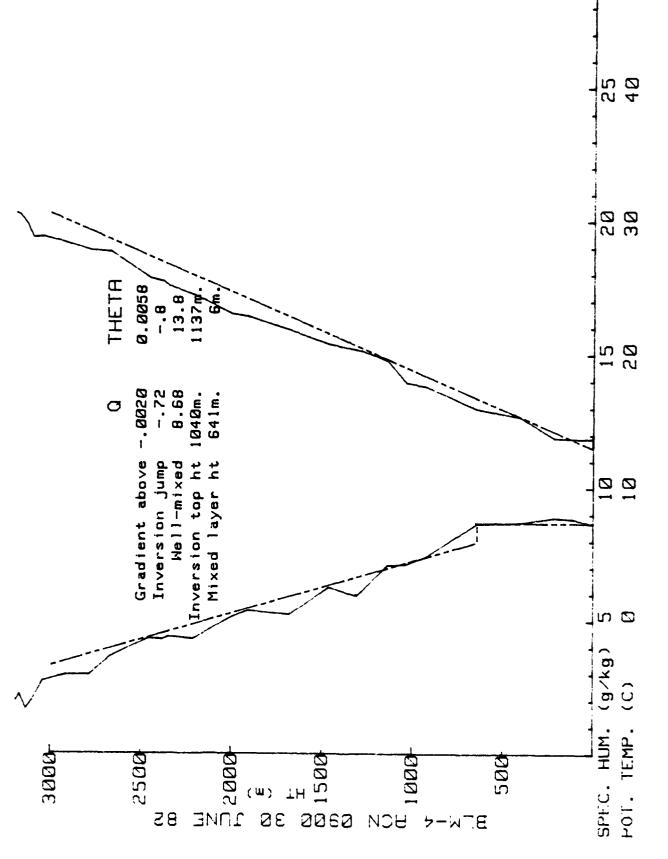
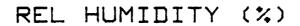
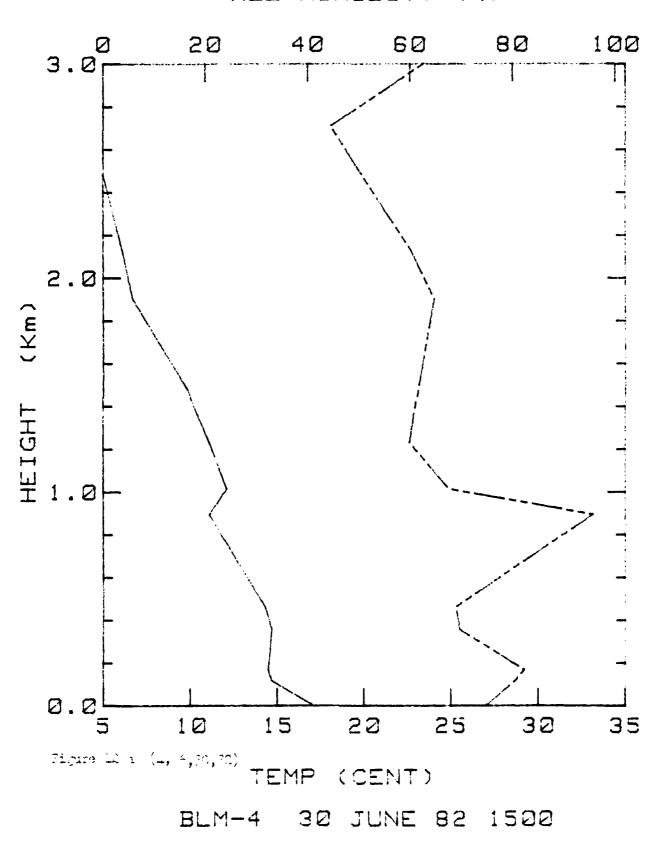
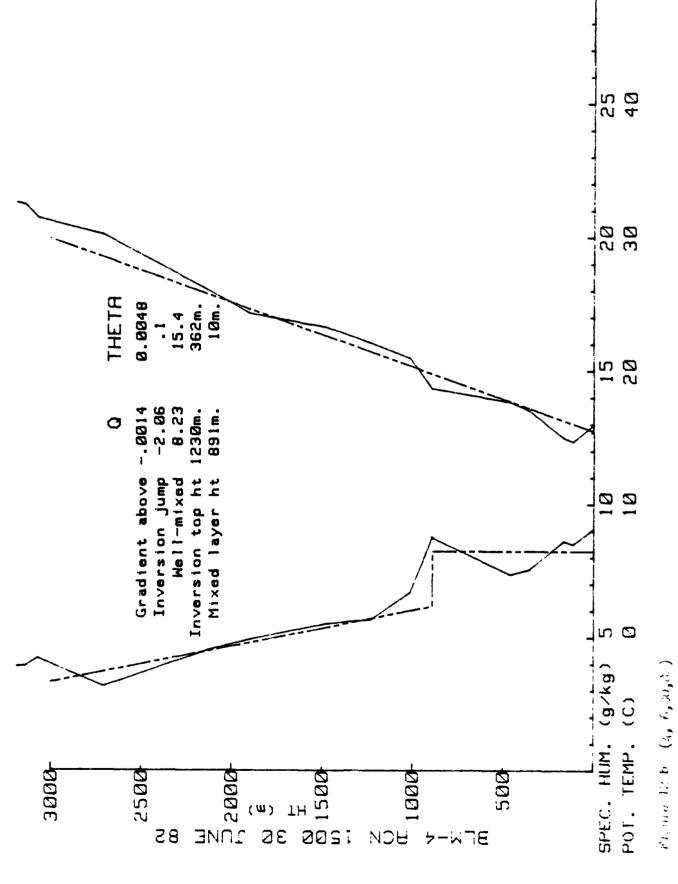


Fig. 1 12 b (a, 6,30,82)

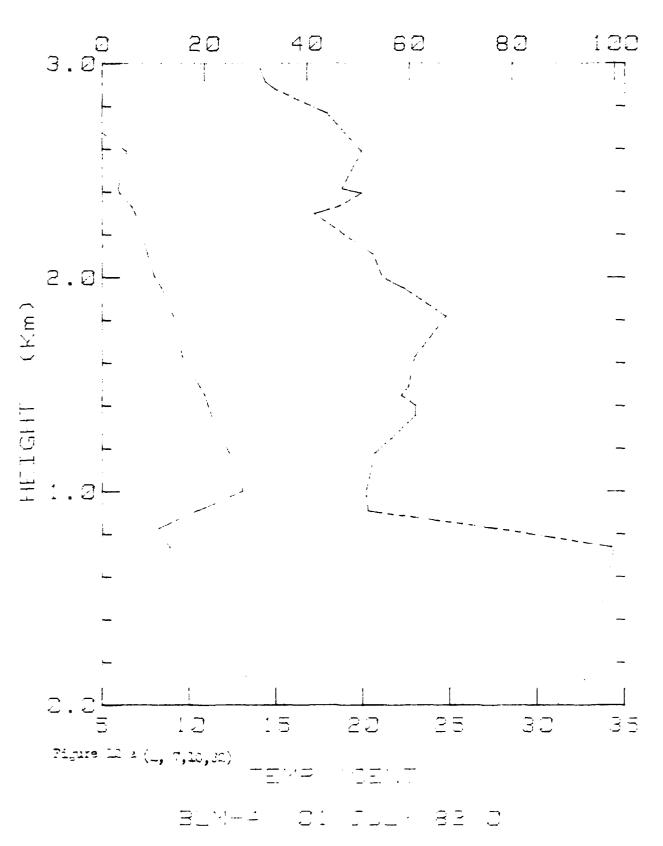


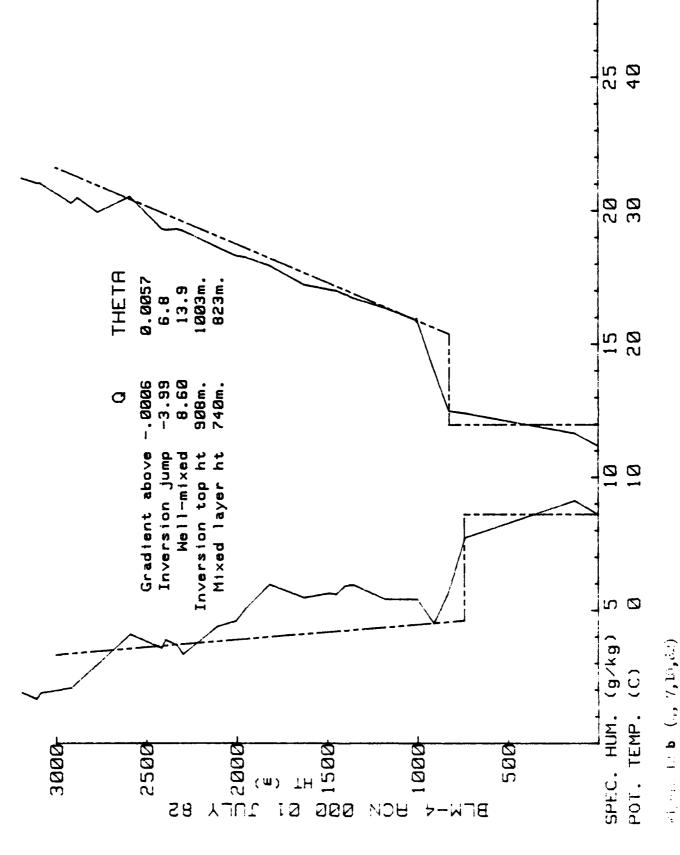


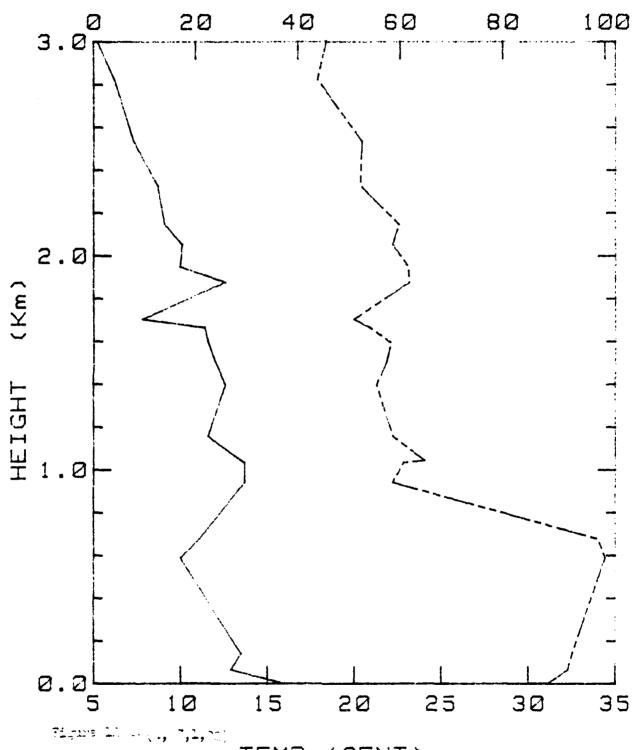


The Control of the Co

Lamite similar hand and shake being her ha

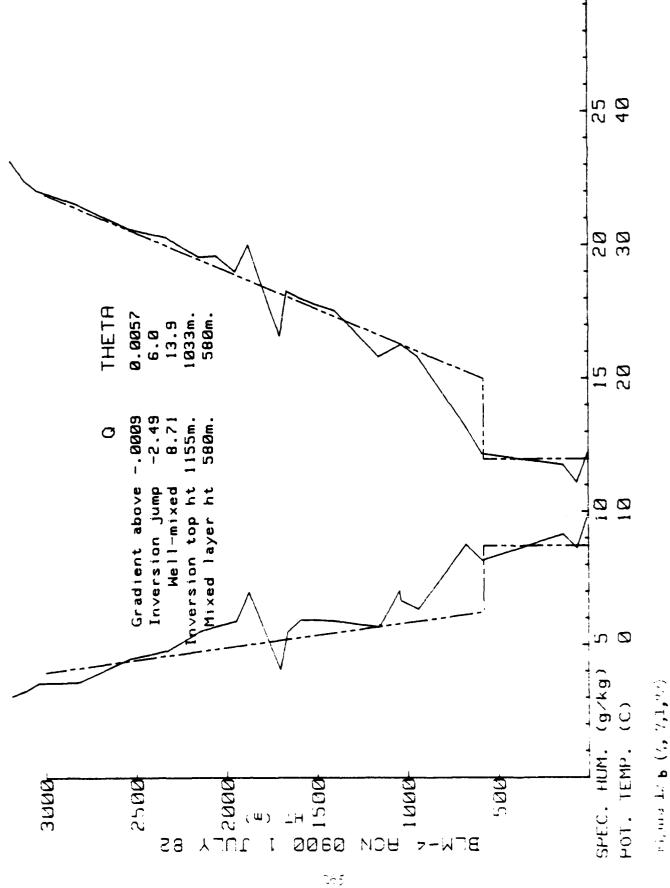


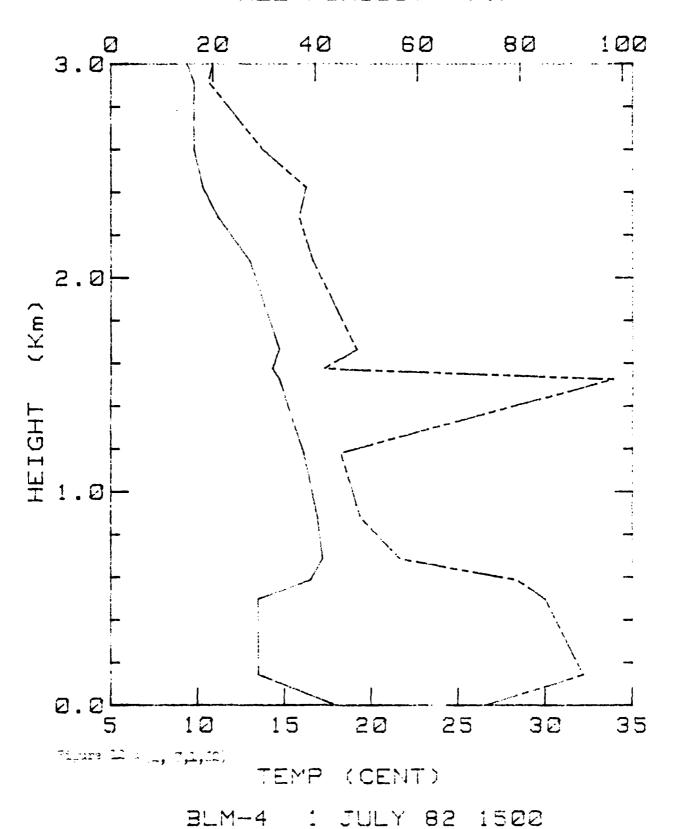


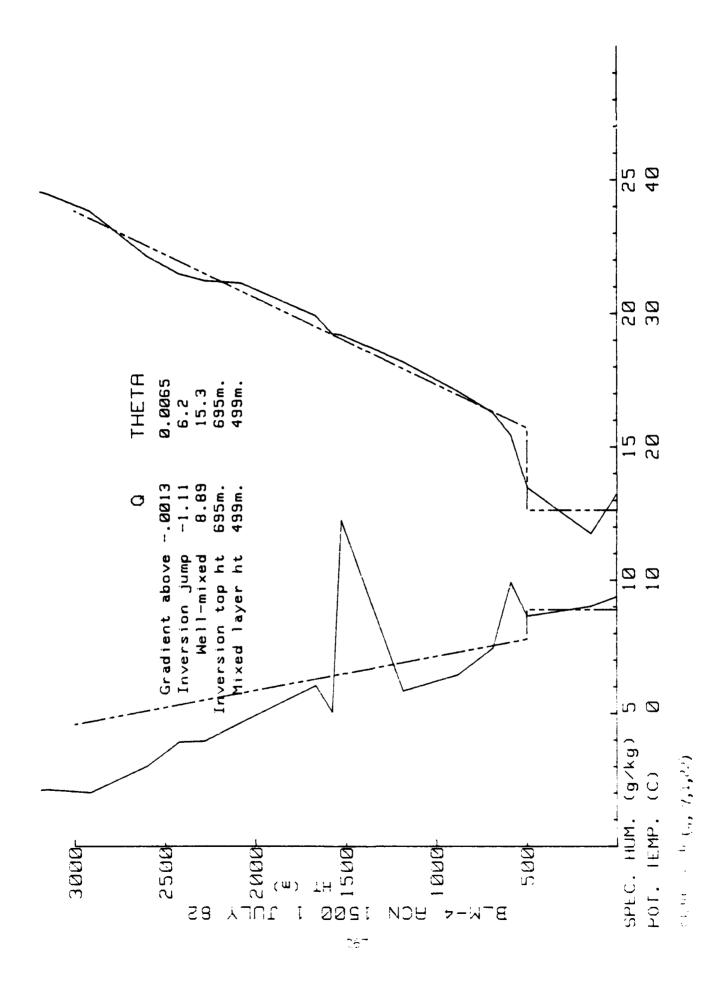


TEMP (CENT)

BLM-4 1 JULY 82 900







#### IV-4. Meteorological Data and Calculated Parameters

Meteorological data was obtained on the ship on a near-continuous basis. Times when valid data could not be obtained, were associated with moving the ship to the release point, or with the wind being from the stern while underway.

These data and all calculated parameters are listed in Table 3. The wind speeds, air temperatures, and relative humidities are those measured at the upper level (20.5 m). All calculated parameters were obtained using the bulk aerodynamic method. The inversion base height,  $Z_{\rm i}$ , was determined from a combination of acoustic sounder and radiosonde data.

The boundary layer mixing velocity,  $\omega_{\star}$ , and the mixing time, t, both depend on the mixing depth,  $Z_{\dot{1}}$ . Thus, during those times when the depth cannot be accurately determined these parameters may be in error.

There are several parameters of interest which are not included in the table because of space limitations. These can be easily obtained from those listed by using the formulas listed in Section III. For example, the rate of dissipation of turbulent kinetic energy,  $\varepsilon$ , can be obtained from the scaling velocity (friction velocity),  $\varepsilon_*$ , using  $\varepsilon_q$ , 15.

Measured and calculated meteorological parameters for BLM-1. Table 8a.

T

BLM #1-80 Release #1

						Release	e #1					
Jate/	r ine	(m/sec)	RH (%)	r (C)	Ts (C)	Z i (m)	(m/sec)	T.*	10+3+Jo (m/seck)	z/L.	(m/sec)	t (min)
AC/60	3.7	2.1	7.3			330	0.073			38E		14.0
42/50	1205	2.1	74	14.6		360	۰.	0.082	115.1	-2.55E 00	0.4	4
10	? ~		73		ڻ	350	• 06		7.	, 78E	_	4
10	301		73			350	.07			1.91E	_	4
10	1329	9.1	72		ٷ	340	• 08		05.	2.97E	_	4
46/60	1357		89	5		330	• 09		21.	1.67E	•	$\sim$
1.5	1425	• (	7.0	5		300	• 13		æ	7.46E-	•	0
12/50	1453	ب ب	7.2	5		280	, 13		02.	6.87E-	•	0
70/60	1521	, c	7.1	7		260	.12		08.	8.54F-	•	0
17/60	1549	9 4	7.2	15.1		240	15		5.	.13E-	•	ထ က
FC/50	1617	5.9	76	2.		250	.20		е В	.75E-	•	۳ ه
09/24	1645	6.4	79	5		260	.22		9.	.09E-	•	<b>အ</b> (
0.8724	1713	5.8	97			270	.20		4.	.79E-		0.6
09/24	1741	9.9	78		8	290	.23		7.	. 1 7E-	•	သ ၊ သ ၊
$\sim$	1809	7	67	4.	9	290	. 24		5.	. 4		7.6
PC/60	1837	7	76	•		280	. 24		5.	1.86E-	•	ლ
0.9/24	1905	ာ ၁	77	•	16.9	280	.23		7.	•	•	α • 2

3LM #1-80 Release #2

						ecrat av	<b>+</b>					
Date/Time		-	<u></u>	÷		Z i	*0	ř.	0+3*.2	7/2	* 3	ų
1	3/un)	(Sec.)	(%)	(C)	(5)	(m)	(m/sec)	(5)	(m/seck)		(m/sec)	(min)
27	15 2	മ	85	13.1	•		• 09	.15	87.	2.39E 0	•	9.3
2.1	43 2	æ	87	12.9	•	S	.09	.16	94.	.51E 0		8.2
09/27 08	59 2	6.	80	14.1	16.9	340	0.098	0.109	138.9	$\neg$	0.5	11.4
5.7	45 4	9	78		•	0	.15	.08	15.	•61E-0		7.4
27	13 3	<b>.</b>	80	4.		8	, 13	.08	08.	.44E-0		12.2
2.7	4] 4	_	30	5.	•		.13	.07	03.	.41E-	•	5
27	38 5	_	30	5.		3	.17	.07	96	.71E-	•	8.3
27	90	_	3.2	4.		$\sim$	.17	.08	.60	. 20L-	•	7.6
27	34 5	10	83	5.	•		• 19	.07	-	.35E-	•	7.2
27	02 5	•	8.2	5.		$^{\circ}$	.20	.07	<b>α</b>	.74E-	•	7.5
27	30 6	<#	8 ]	δ.	•	_	.22	• 06	7.	.04E-0	•	7.5
27	58 6	ع	11	5.			.22	• 05	9.	.80E-0	•	7.6
27	26 7	S	80	5.	•	0	.27	• 05	3,	.19E-0		7.4
2.7	54 8	~	11			Ø	.29	.04	9	.84		7.0
27	22 8	<b>⊕</b>	11	5		$\sim$	.33	• 03	9	6.18E-0		8.2
27	50 8	_	75	9	٠	3	.28	.02	ъ ж	.06E-0		0
2.3	18 7	an.	7.5	9		S	.27	.01	÷	6.45E-0	•	12.2
2.7	46 7	c.	11	<b>.</b>		S)	.27	.01	ဆ	.87E-0		<del>ئ</del>
27	14 7	~	30	9		-	.25	.02	-	.37E-0	•	۳,
27	42 8	_	30	•	7	er.	.28	.02	<del>.</del>	.23E-0		6.9
27	10 7	_	80	9		₹*	.24	.03	0	.00E-0	•	7.2
5 7	38 5	മ	30	٠	9	O	.20	.02	<u>ئ</u>	.47E-0	•	8.4
2.1	90	œ	80	5.	•	9	. 19	.02	9.	.58E-	•	8.5

JLM #1-80 Release #3

t (min)	12.6 11.6 11.6 6.1 6.5 8.0 19.5 20.0 20.0	(min) 5.8 18.0 22.5 20.6 21.1 22.3 91.9 20.8 23.3 22.7 37.5 31.4 32.5
W# (E/Sec)	00000000000	(m/sec) 0.3 0.3 0.3 0.3 0.3 0.2 0.1 0.2 0.1
z/L	-1.77E 00 -1.43E 00 -9.35E-01 -1.74E 00 -7.41E-01 -6.72E-01 -5.32E-01 -5.82E-01 -8.08E-01	2/L -2.20E 00 -1.76E 00 -7.80E-01 -4.26E-01 -2.85E-01 -2.32E-02 -2.32E-02 -7.72E-02 -7.72E-02 -7.72E-02 -7.72E-02 -7.120E-01
10+3*Qo (m/seck)	68.0 70.0 69.1 104.0 90.5 70.1 50.8 51.1 52.9	10+3*00 (m/secK) 117.0 76.9 50.3 46.7 40.5 19.5 10.0 17.3 21.8 22.0
T.*	0.045 0.046 0.046 0.077 0.065 0.029 0.030 0.032	(C) 0.090 0.052 0.027 0.024 0.018 0.000 0.002 0.002 0.002 0.002
(m/sec)	0.067 0.094 0.094 0.084 0.100 0.116 0.116 0.106 0.1075 0.088	
2 i (m)	210 200 160 160 400 120 140 400 400 400 8EM #1	
rs (C)	17,1 17,2 17.2 18.1 18.0 17.8 17.8	frs (C) 16.1 16.2 16.3 16.3 16.0 16.0 16.0 16.0 16.0
1. (C)	15.8 16.9 16.8 16.8 16.8 16.8 16.9 16.9	(C) 13.8 14.6 15.4 15.4 16.0 16.0 16.0 16.0 15.9
Kel	8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	Rad (4) (4) 80 76 76 76 76 76 76 76 76 76
U (m/sec)	2222 2222 2233 2334 235 235 235 235 235 235 235 235 235 235	0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
rime	1307 13335 14408 1436 1504 1532 1628 1740 1836 1904	0.1 Le/Time 9/29 1217 9/29 1217 9/29 1245 9/29 1319 9/29 1443 9/29 1443 9/29 1443 9/29 1443 9/29 1443 9/29 1443 9/29 1484 9/29 1722 9/29 1722 9/29 1846 9/29 1818
Date/Pime	09/28 09/28 09/28 09/28 09/28 09/28 09/28 09/28	09/29 09/29 09/29 09/29 09/29 09/29 09/29 09/29 09/29

----

Measured and calculated meteorological paramenters for BLM-2. Table 8b.

BL-1-2 1981	All Data	

t (niin)	•			•	•	•	•		•	2,	•	4.	•	2	•	~	0	•	•	10.2	<b>:</b>	•	2	-Jr	·	10.5	·1	•	٠	11.5	•	13.0	•	. J	7.1	7.1
w* (m/sec)	•	0.3	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•		•	•	•	•	•	•	•	•	•		•	•	•	•	•	•
z/i.	-40F-	9.79E-02	-05E-	.39E-	.uSE-	.35E-	.40E-	-24c-	.72L-	-95o.	.74E-	.62E-	.76E-	.19E	. 34E	.27L-	. 2d E	.49E-	. y41.	3.42ビー	2.53E-	2.30E-	.13E-	1.456-	-7967.	2.43E-	2.105-	1.076-	9.16L-	.25E-	.14E-	1.00E-	-328.	8i:-	.79E-	- 4 2E-
10+3*Jo (m/seck)	18.	-21.5	30.	19.	42.	34.	29.	30.	42.	3	lí.	3	*	•	-	;	7.	'n	÷			7	3	•	3	<b>;</b>	ċ	٠ ئ	က်	7.	4	7.	<u>.</u>		٦,	ສໍ
f* (C)	ú.03	-0.041	0.05	ŭ. U3	0.06	0.05	0.05	0.05	0.06	0.04	0.03	0.01	. ol	00.	. u	.00	2	.04	4	U3	. ს3	U.3	.02	o.	-	. 00	0.001	.00	<b>0.00</b> 8	, u	.02	0.00	7.7	0.01	0	0.2
U* (IN/sec)	.17	0.163	. 11	.05	. 15	. 13	.15	. 12	.13	. 10	ခို	. 05	.10	.05	. ს5	.05	. ი 5	.12	. 13	.13	. 15	. 15	٠15	. 16	.13	10	υ,	. 13	.15	.17	.12	.09	.03	<	.15	.17
2 i (m)	9	160	9	9	2	7	အ	$\infty$	160	160	140	140	100	200	100	100	loo	30	160	200	240	240	250	260	2ö 0	200	180	160	120	100	180	100	100	100	100	100
1's (C)			2	5.	5.	5.	5.	Š.	•	5.	5.	5.	ت	5.	5.	5	6.		2	٠	$\mathbf{c}$	5	5.	5.	ŝ		5	5.	ۍ	5.	S.	٠ د	ů.		5	5.
يا (ث)	•	16.8	7.	7.	۲.		۲.	7	ά.	<u>.</u>	ė.	Ġ.	ż	5.	S.	5.	ς.	÷	4.	4.	4	4.	•	•	<b>∵</b>	•	٠.	ŝ	5.	۶.	4.	5.	9		•	5.
( <del>%</del> )	ίί	99	0.9	t 0	53	58	o l	10	25	00	60	55	70	11	7.4	9/	7.9	73	<del>1</del> .	3	67	នស	0.7	4.	S S		o <b>3</b>	/. R	88	çç	7.0	7.9	7.9	76	73	1.1
(398/m)	•	5.3	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
r tme	35	1425	₹.	54	۲,	4	7.1	4	-	-7	<b>→</b>	7847	1232	1320	1350	1420	1450	1145	1771	1309	1339	6041	14.59	1509	1539	1009	1035	1709	1739	1409	0.852	4	<del></del>	1111	$\sim$	$\supset$
Date/Time	01/00	$\Rightarrow$	)	\	01/10	01/00	\	01/00	`	`	01/06	$v1/v_0$	01/0/	10/10	10/10	01/07	01/07	60/10	60/10	60/10	01/09	60/10	(0/10	60/10	U1/03	01/09	60/10	60/10	01/09	01/03	01/13	01/13		01/13	7	01/13

BLM-2 1981 All Data

t. (m1.0)	ଦ ୧୯	5.3	ა ა.	J. 3	د. ي	7.0	$\supset$	7	11.0	$\supset$	12.3		$\sim$			47.1	43.1	10.4	lu.y	2.0	10.0		•	÷	6.02	7.	ъ с	17.5	٠ د	15.3	5.	٠.	·	13.1	•	lo. v
(m/sec)	•	0.3	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•										
z/L	.496-0		. 10E-U	. U 2E-U	.U7E-U	.58L-U	71E-0	.32E-U	.52E-0	1.006-0	2.02E-U	.536-0	.82E-0	.336-0	. 76c-u	. U4 E-Ú	.34E-U	4.236-0	Ð-1	.87E-0	.32E-U	<b>56E−0</b>	. 026-0	0-3	. 4 3c-	.40E-	100r	·ole-	Э	. 41	. 10	-9.22E-01	7.33	-3.38E-Ul	1.701-	. 76
10+3*20 (m/seck)	14.	-27.5	2 b	20.	16.	13.	٠,	4.	~•	•	χ.	~	÷	ģ	· -	<b>-</b>	2	ċ	;	٠,	4.	Š.	4.	ģ	•	÷	٠ •	Š	<del>-</del>	ά.	5.	•	ાં		•	m
T.*	0.0	-0.046	ი. ი	ი. ი	0.	0.ú	0. Û	0.0	0.0	0.	٦.	0.	٦.	٠.	• •	٦.	o.	٦.	Ξ.	٦.	0.	٦.	<b>∵</b>	Э.	0.042	Э.	⊃.	3.	٦.	o.	ં	0.04B	?	Э.	·	0.027
(in/sec)	•	û. 194	. 17	.17	.15	.16	.12	. 13	.13	.09	. 06	.07	.07	.05	.05	.05	.07	.10	.16	. 12	.17	. 21	. 20	.09	. O8	. 13	0.113	. 10	0.102	. 10	. <u>1</u> 0	0.092	0.101	•	0.179	0.172
6 i (m)	100	100	100	100	100	130	130	130	130	100	100	08	50	50	180	180	200	150	200	001	360	260	120	500	200	001	400	400	3 3 0	380	360	340	320	nns	400	00%
.f.3 (C)	2	15.4	2	5	2	2	S	2	Ω	2	5	5	S	S	5	5	$\mathcal{S}$	2	S	5	2	S	5	2	5	9	٠0	•	10.7					16.3		
r. (5)	9	17.0	9	9	ō	5.	5	5.	5	5.	5.	5	5.	5.	5.	5	5.	4.	4.	5.	4	÷	4.	4.	4	5	5.	5.	4.	4.	•		5.	5	S	2
(%)	7.1	t 0	t 0	7.1	α	υ 2	37	83	83	99	70	7.5	11	ıβ	85	86	38	86	84	40	35	33	53	<b>છ</b>	ន	8.2	ر ع	<u></u>	λ2	χ 4-2	ć, i	65	၁	\$ 4	ΩŊ	79
(in/sec)	•	. · · ·	•	•	•	•			•	•	•	•	•	٠			•	•	•	•	•	•	•	•	•	•	•	•	٠	•	•		•	•	٠	•
r me	1339	1409	∻	5	1551	S	ာ	0	1729	1130	1200	1230	1300	1330	1400	1430	1500	1441	1500	1552	1022	1052	1.722	0930	1008	1050	1120	1150	1220	1250	1320	1350	~1	1450	7	
Date/Fime		01/13	01/13	01/13	01/13	01/13	01/13	01/13	01/13	7	01/14	01/14	01/14	01/14	01/14	7	1/1	$\overline{}$		_	01/15	u1/15	1	01/10	01/10	7	01/10	01/10	01/10	01/10	01/10	01/10	01/10	01/10	ul/lu	01/10

BLM-2 1981 All Data

nate/fine	3	Kil	-	S,I	. 7. j	* 0	*	10+3401	z/L	* 3	'n
	(m/sec)	(%)	(5)	(3)	(m)	(m/sec)	(5)	(III/Seck)		(m/sec)	(nin)
	1.0	ι. 3	15.4	16.1	400	0.175	0.022	37.9	-1.466-01	0.4	17.3
	6.4	49	15.5	10.1	400	0.180	0.016	30.5	-1.04E-01	0.3	19.3
		92	15.4	16.0	400	0.194	0.017	30.0	-9.37E-U2	0.4	16.7
01/16 1750	7.0	87	15.4	10.0	400	0.176	0.019	30.8	-1.176-01	0.4	16.0
	5.3	3.5	15.5	15.9	400	0.141	0.011	23.1	-1.40E-01	0.3	7.47
	4.7	αÇ	15.5	15.9	400	0.122	0.010	21.9	-1.73E-01	0.3	26.0
	4.3	3 3	15.5	15.9	430	0.105	0.010	21.1	-2.26E-01	0.3	31.1
	3.2	ري ري	15.4	15.9	480	0.073	0.015	26.7	-5.90E-01	0.3	30.5
	l. d	68	15.3	15.9	480	0.032	0.021	33.5	-3.40E 00	0.2	36.0
	Ú. 8	υ'n	15.1	15.8	400	0.044	0.022	33.6	-2.03E 00	0.2	28.1
	3.1	91	15.1	15.9	400	0.069	0.023	33.2	-8.32E-01	0.3	24.0
	4.3	35	15.1	15.8	400	0.127	0.019	28.3	-2.074-01	0.3	20.7
	7.0	ر 0	15.2	15.8	260	U. 170	0.017	26.3	-1.03E-01	0.3	14.5
	7.1	16	15.2	15.7	160	0.211	0.012	7.11.	-6, 428-02	0.2	71.2

Measured and calculated meteorological paramenters for BLM-3. Table 8c.

	3
	Z/L
	10+3*00
	<b>*</b>
81 ta	<b>*</b>
PLM 3 81 All Data	Ts Zi
	SE
	<b>:-</b>
	RE
	<b>D</b> .
	te/Pime

t (min)	•	0.0			•			•	<u>0</u> د	•	•	•	•	•		•	•	•		•	0	•	15.6	4.	5	÷	0			6	·	<b>。</b>	ä	•	<b>.</b>	2.
w* (m/sec)		0.0			•			0.0	•	•		•	•	٠	•	•	•	•				•	0.1	•	•	•	•		•		•		•	•	0.3	0.4
z/L	.99E	6.00E-01	.76E-	Э86.	366.	.398	.126	. 64E	(16.6	.56E	.84E	366.	. 92Е	.99E	.99E	.99E	366.	.99E	. 99E	. 99E	. 8 SE	.12E-	.03E-	2.37E-	. 0 SE-	.31E	.07E	. 23E	.22E	2.77E	-390·	.17E-	.40E	2 SE	.73E	. 4 2E
10+3*Co (m/secK)	0	-40.0	5.	20.	ci	3	22.	Š	=	15.	÷.	0	2	0.	•	•	•	•	•		•	ä		2.	4.	۳,	ij	6	7.	3,	7.	97.	09.	•	18.	21.
T* (C)	0.0	-0.063	0.0	<b>-</b>	0	· .	<u> </u>	0.0	Ξ.	0.0	•	0.0	c.	٥.	0.	0.	0.	0.	0.	0.	•	•	0	0.	0.	0.	0.	•	0.	•	•	0.	0.	٦.	٦,	
U* (m/sec)	00.	0.091	.07	.02	00.	00.	. 02	.02	G	.03	.01	00.	00.	00.	.00	.00	00.	00.	00.	00.	.03	.06	.08	.07	.05	.04	90.	• 06	.04	• 06	.12	.11	.05	.04	.04	• 05
Z i (m)	80	80	80	80	80	80	80	80	<u>چ</u>	0 8	80	80	80	$\sim$	$\sim$	$\sim$	$\sim$	$\sim$	$\sim$	3	$\sim$	3	130	$\sim$	$\sim$	$\infty$	7	7	7	0	9	8	4	290	^	ω
Ts (C)	2	12.8	<b>∵</b>	2.	ن د:	ς.	•	•	•	•	•	٠	•	•	۳,	٣	<del>.</del>	2	2	2.	2.	5	12.7	2	2	2	5	2.	7	7	2	2.	2	5	2.	2.
T (C)	•	15.0		•					٠	•	•	•		4.	4	4.	4.	4.	4.	4.	ж.	2	12.4	7	2	2	ij	0	0	0	ċ	ċ	ċ	•	ċ	0
RH (*)	34	3.4	33	33	bζ	<del>7.</del>	<del>-</del>	£ 9	0.0	6.4	62	69	75	75	73	69	7.1	72	75	74	78	80	80	75	74	11	84	96	0	207	0	66	86	16	94	95
(n/sec)	•	3. d	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	٠	•	•	•	•	•	•	•		1.4
Date/Pime	/08 110	12/03 1119	/08 - 112	/08 113	/01 114	708 115	Oct on	1.1 : 07	713 134	703 135	703 - 142	ZOB 115	708 152	708 155	/08 162	/08 165	2/08 172	708 175	2/08 182	2/08 135	2/08 192	2/08 195	202	2/08 205	2/08 212	2/08 215	2/08 222	/08 225	/08 232	/08 235	/09 002	709 005	709 012	709 015	/09 022	/09 025

BLM 3 81 All Data

t (min)	<del>.</del>	•	0	<b>&amp;</b>	0	2.	5	4.	•	5	2	<del>.</del>	2.	7.	6	2	·	5	5.	0	6	0	5	7	•	•	•	•	•	•	•	•	•	0.0		•
(m/sec)	•	•	•	•		•	•	•	•	•	•		•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	0.0	•	•
z/L	3.96E	.73E	1.73E	3.84E	8.89E	1.19E	2.72E	3.32E		.22E	26	4.32E	2.291:	.78E	.418	.12E-0	2.42E-0	.09E-0	2.78E-0	2.885-0	2.80E-0	.13E-0	3.04E-0	.55E-0	.36E 0	1.74E-0	.12E-0	.24E-0	.84E-0	1.19E-0	.71E-0	.56E-0	.31E-0	-1.756-02	.728-0	3.280
10+3*Qo (m/secK)	14.	14.	.60	37.	43.	33.	14.	08.		14.	22.	25.	27.	44.	<u>.</u>	4	<del>.</del>	₹	7.	<b>;</b>	5	ຕໍ	6	6	2.	•	٠	7.	9	•	•	•	•	6.0		•
T* (C)	. 10	.10	60°	. 12	. 12	.11	. 10	• 09	.09	• 09	.10	. 1.	. 11	. 12	.08	.03	.03	.03	.02	.02	.02	.02	.01	.01	• 00	00.	.01	.01	.01	.00	00.	.00	.02	-0.007	. 01	00.
U* (m/sec)	.05	• 06	.08	90.	.04	.03	.07	• 06	90.	90.	90.	.05	÷.	.03	.05	.13	. 14	.10	. 12	. 11	. 11	. 11	.10	.08	.02	. 04	• 05	.05	• 00	.17	.08	.07	.08	0.065	.03	.02
Zi (m)	$\rightarrow$	6	2		2	4		S	330	2	_	3	1.0	$\overline{}$	-	$\sim$	₹7	4	S	$\infty$	$\infty$	2		3	0	0	0	0	0	С	C	0	0	0	c	C
Ts (C)	2	3	2	?	2	2.	?	2.		2	2	2	$\stackrel{{}_{\sim}}{\sim}$	2:	~	<b>~</b> :	~	$\sim$ i	$\bigcirc$	~	~	~	C	2					$^{\circ}$	~	~	0:	$\mathbf{c}$ :	12.4		
r (C)	0	•	0	•	•	•	•	•	10.3	•	•	0		6.7	10.2		11.4	11.4	11.6	•	•	•	•	•	•	•	•	•	•	•	•	•	•	12.5	•	•
RH (*)	95	94	95	96	96	94	94	93	91	95	65	43	F	ئ رئ	<u> </u>	06	88	88	8.7	85	8.5	85	98	85	83	82	8.1	81	80	83	82	85	78	3.4	<u>~</u>	<b>46</b>
(m/sec)	1,6	•	•	•	•	•	•	٠	2.0	•	1.7	•	<u>.</u>	0.7	1.7		•	•	•	•		•	٠	•	•	•	•	•	•		•	•	•	2.2	•	~ •
'T ine	•	. ^	^ 1	. ^	^1		$\sim$ 1	. ^	0.722	. ^	$\Delta 1$	ß	67.61		C:	S	<b>(^1</b>	S.	$\sim$	5	2	S	1422	5	7	2	62	5	$\sim$	5	$\sim$	5	?	1952	₹60€	6506
Date/Time	12/09	9	12/09	9	9	12/09		12/09	15/00	12/09	12/04	12/09	12/00	1.0761	15/07	12/019	15/00	12709	12/00		12/09	12/09	12/99	12/08	12/09	12/09	12/09	12/00	12/04	12/09	12/00	12/09	12/04	12/04	17/03	1.2/0.4

**3** 31

out velice	(8.757.d)	- ( ) - ( )	÷ ()	1 s (C)	ξ. (π)	(၁৬3/u) *!)	<b>*</b> 50	10+3*0c (a/se K)	2/f.	(a) sec)	t (min)
/03 212	1.4	93	•	•	С	. 04	.01	0	.08E 0	•	•
15/u/0 5152	1.1	94	11.9	12.4	0	0.038	0.018	23.6	-1.89E 00	0.0	0.0
/09 222	•	96	i.	2.	0	.03	.02	2.	.68E O	•	•
/09 225	•	98	Ϊ.	2.	0	• 06	.02	_	9.64E-0	•	•
/09 232		98	_;	2.	0	.04	.02	2.	2.13E 0	•	•
/09 235	•	86	<b>;</b>	2	0	.03	.03	6	3.77E 0		•
/10 002		86	-	2.	0	.04	.03	9	2.50E 0	•	•
710 005	•	86	;	2.	0	• 06	.03	φ.	1.06E 0	•	•
/10 012	•	96	•	2.	0	.07	.03	0	.29E-0	•	•
710 015	•	95	1	2.	0	.05	.03	0	1.37E 0	•	•
/10 022	•	94	Ţ.	2.	0	.07	.03	7.	7.68E-0	•	•
/10 025	•	94	ä	2.	0	.04	.03	5.	2.43E 0	•	•
2/10 032		94	į.	2.	100	.04	.03	9.	1.94E 0	•	•
2/10 035	•	95	<b>-</b>	2.	0	.03	.02	۳,	.60E 0	•	•
2/10 042	•	96	1	2.	0	.04	.02	9	1.66E 0	•	•
2/10 045	•	96	;	2.	0	.05	.02	8	.76E-0	•	•
2/10 052	•	93	2.	2	0	90.	.00	œ,	.31E-0	•	•
2/10 055	•	92	2.	2.	0	• 09	.00	•	.83E-0	•	
2/10 062	•	91	2	2.	0	. 12	00.	•	.24E-0		•
2/10 065	•	92	2	2.	0	.11	.00	7.	.24E-0		•
2/10 072	•	89	2.	2.	0	.12	.00	<del>.</del>	.35E-0	•	•
/10 075	•	90	2.	2	0	.12	.01	0	.68E-0	•	•
2/10 082	•	91	2.	2	0	. 10	0.00	S.	.72E-0	•	•
2/10 085	•	92	ä	2.	0	90.	.04	ထ	1.59E 0	•	•
/10 102	٠	96	0	7	0	.07	90.	5.	1.55E 0	•	•
710 105	•	94	-	2.	0	.07	.05	ä	.39E 0	•	•
/10 112	•	94		7	0	.07	.03	6.	8.79E-0		•
/10 115	•	95	į.	5	0	• 0 9	.03	0	5.20E-0	•	•
/10 122		95	<b>;</b>	2	0	• 04	.02	2	.06E 0		•
/10 125		92	2	7	0	• 03	.01	7.	1.38E 0		•
/10 135		88	•	2.	0	.04	.00	<del>-</del>	.62E-0	•	•
/10 142	•	98	•	7	0	.02	00.	2.	.38E-0	•	•
710 145	•	84	•	12.7	C	90.	.02	4.	.30E-0		•
/10 152		71	•	12.7	0	• 00	.05	•	.75E-0	•	•
/10 155	•	99	•	12.7	0	90.	.05	50.	.37E 0	•	•

BLM 3 81 All Data

t nin)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•		0.0	•	•	•	•
E) (:	J	_	_	_		_	_	_		_	_	_	_	_	_		_	_	_	_	Ŭ	_	_	_	_	_			_	_	_	_	Ŭ	_		_
w* (m/sec)	•	•	•	•		•	•	•	•	•	•	•			•	•			0.0							•				•	•	0.0		•	•	•
z/L	8E 0	5 SE 0	.67E-0	.34E-0	.32E-0	.87E-0	.89E-0	.11E-0	.11E-0	.13E-0	.08E-0	.99E-0	1.47E-0	.79E-0	.90E-0	.91E-0	.29E-0	.71E-0	44E-0	.73E-0	2.83E-0	2.05E-0	.49E-0	.8 2E-0	.728-0	.388-0	0-500.	.550	.72E 0	.61E 0	8E 0	-2.37E 00	.35E 0	4E 0	.45E-0	· 69E-0
10+3*Qo (m/secK)	į.	9	32.	35.	ä	2.	7.	9	18,	5.	-	-	<del>ب</del>	6	7.	ä	4.	2.	9.	0	7.	4.	9.	3,	๙๋		7	0	<b>ث</b>	7.	_	64.3	0	÷.	į,	2
T*	0.00	.03	.04	.05	.05	.02	0.03	.04	.03	.03	.03	.01	90.	00.	.01	.02	.03	.00	.00	00.	.01	.01	.03	.03	.04	.03	.05	.07	.04	.04	.04	0.042	.03	.03	.02	.01
U* (m/sec)	00•	. 04	. 10	. 10	. 12	.05	.08	. 12	. 10	. 14	.11	. 17	.13	. 13	.15	.17	.16	. 14	• 00	.07	.12	. 14	,21	. 38	.20	.17	1.1	.06	90.	.07	90.	0.056	.04	.05	.07	.15
2 i (m)	0	100	0	0	0	0	0	0	0	0	0	0	0	0	c	0	0	0	0	c	0	0	С	C	C	C	0	C	C	С	С	С	C	0	0	0
Ts (C)	12.7	12.6	•	•	•	•	•	•	•	•	•	•	2	2.	2	2	2	2	•	2.	2.	2.	2	•	•	•	•	•	•	•	•	12.6	2.	•	•	2.
T (C)	4	4.	4.	4	4	۳,	۳,	<del>.</del>	٣,	۳,	~	2.	5	2	2	_	_;	2.	12.5	2.	2.	2.		_;		•	•	•	•			11.5	•	•	•	12.1
RH (8)	74	62	09	28	52	59	26	54	52	54	57	99	62	63	9	65	99	63	62	63	99	29	4	19	68	6.19	12	7 }	70	7.1	72	73	72	72	75	75
U (m/sec)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•		•	•			•	•		1.6	•	•	•	•
Date/Time	110	/10 ]	/10 1	/10 2	/10 2	/10 2	/10 2	/10 2	/10 2	/10 2	/11 0	/11 0	711 0	0 11/	2/11 0	2/11 0	2/11 0	2/11 0	11 0	2/11 0	2/11 0	/11 0	/11 0	7.11		12/11/0739	12/11 0800		=======================================			12/11 1030	/11 11	71 1	/11 12	/11 13

BLM 3 81 All Data

t (min)	•		0.0		•					•						2	۳,	7	•	m m	9	æ	•	0	7	•					•	•	•	•	•	0.0
(m/sec)	0.0	•	0.0	•	•	•	•	•	•	•	•		•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
z/L	.81E-0	.49E-0	9	4.25E-0	.34E-0	.01E-0	.70E-0	.926-0	52E-0	34E-0	.528-0	.798-0	.78E-0	1.26E-0	.08E 0	2.39E-0	.39E 0	1.30E 0	1.12E 0	.10E-0	5.62E-0	8.45E-0	2.38E 0	. 4 OE -0	.18E-0	1.93E-0	8.85E-0	1.30E-0	.75E-0	3.85E-0	.61E-0	.98E-0	.08E-0	.8 5E-0	.95E-0	.24E-0
10+3*Qo (m/secK)	5.	•	4	٠	•	•	•	•	•	•	•	•	•	7.	•	•	9.	<b>ж</b>	5.	۳,	ထ်	0	•	4.	9	9	0	7.	2	7.	ŗ,	6	÷	•	17.	6
T**	00.	00.	-0.004	.01	.01	.00	• 00	00.	00.	00.	00.	0.01	0.01	00.	.04	00.	00.	.01	.01	.01	.01	.01	.00	00.	.01	.04	.01	.03	.01	.01	90.	.01	.01	.02	.02	.02
U* (m/sec)	. 12	. 12	$\overline{}$	.19	.23	.25	. 26	.26	.29	.26	.23	. 18	. 14	.08	.08	90.	.02	.04	.05	.07	90•	.05	.03	.05	.12	• 16	.16	. 18	.21	.23	. 24	.23	. 20	. 16	.17	.19
Z i (m)	0	0	0	0	C	0	C	C	0	С	C	0	0	C	0	$\infty$	0	œ	S	2	8	9		9	9	8	2									09
Ts (C)	2	2.	12.9	2.	2	2.	2	2.	2.	<i>?</i>	~	ر : ح	2	2	2	7	2.	2	2.	2.	2.	2.	2.	3	3.	3	2.	2.	2.	2	7	7	7	7	7	2.
r (C)	•	•	12.9	•	•	•	•	•	•	•	•	•	•	•	•	2	2.	•	2.	2.	2	2.	2.	2.	2.	;	2.	•	2.	•	•	•	٠	•	•	•
P.II (8)			7.0					8.2	.8]	<del>د</del> 0	0 <b>%</b>	<del>2</del>	8.	84	06	88	88	8 9	06	06	8 9	8	88	06	95	86	96	16	98	96	92	91	93	89	90	06
(m/sec)	•		4.3	•	•	•	•	•	•	•	•			•	•	•	•		•	•	•	•	0.8		•	•	•	•	•		•	•	•	•	•	•
nate/Pime	/11 13	12/11 1400	111 1	711	/11 1	12/11 1600	/11 1	12/11 1657	12/11 1724	12/11/11/51	12/11/1818	11/11 1816	=	11/	12/11 2006	/13	/13	_	/13	/13 0	/13 1	13	/13 1	12/13 1230	/13	/13 1	/13 14	/13 14	/13 15	12/13 1530	/13 16	12/13 1630	12/13 1700	12/13 1730	12/13 1800	/13 1

**-**---

BLM 3 81 All Data

C

t (min)	•	•	•	•	4.	•	7	Š	5	2.	2	•	•	•	•	•	•	•	•	ထ	•	•	•	•	•	•	•	•	•	•	•	•	•	0.0	•	•
w* (m/sec)	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•		•	•	•	•	•	•	•	•	٠		•	•	•	•	•	0.0	•	•
z/L	.04E-0	.55E-0	49E 0	.99E 0	1.71E-0	.60E-0	4.85E-0	3.26E-0	5.78E-0	2.06E 0	3.36E 0	2.94E 0	1.96E 0	8.45E-0	.17E-0	2,008-0	2.57E-0	3.290-0	1.18E-0	.53E-0	1.39E-0	.95E 0	.71E 0	.22E 0	5.39E 0	2.23E 0	.11E 0	1.02E 0	.04E-0	.38E-0	.49E-0	.90E-0	.94E-0	1.66E-01	.358-0	.77E-0
10+3*Qo (m/seck)	19.	9	18.	0.	•	•	•	•	9	7.	•	ä	5.	0		Ġ	<b>;</b>	4	9	ŗ,	0	2	2.	æ	•	5.	6	7.	2	•		22.	5.	-43.2	۳,	٠ و
T* (C)	0.02	0.02	.02	0.00	0.00	0.00	0.00	0.00	90.	00.	.01	.02	.01	.01	00.	.00	.01	00.	.01	00.	00.	.02	.02	.03	.02	.03	.02	.01	0.01	.01	0.01	0.03	0.04	-0.051	0.04	.03
U* (m/sec)	. 15	.07	.03	00.	.02	.04	.03	.03	.03	.03	.02	.03	.03	.05	• 08	.09	.09	.07	. 12	. 13	.09	.04	.04	.03	.03	. 04	90.	.05	.03	.04	.03	. 11	. 14	0.176	.20	.20
2 i (m)	09	09	09	09	09	09	09	09	09	09	09	09	09	09	60	90	60	9	0.9	09	09	09	09	09	09	09	09	0.9	09	09	09	09	09	09	09	0 9
Ts (C)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	٠	•	•	•	•	•	•	•	٠	٠	•	12.7	•	•
T (C)	3	۶.	<u>ج</u>	<del>.</del>	2	2.	2	2.	2.	2.	2.	2.	2.	ci.		٠,	oi.	3	<u>:</u>	ci	2	2.	<del>-</del>	_;	Ϊ.	<u>.</u>	_;	2.	<u>.</u>	<del>.</del>	~	3,	4.	14.5	<b>~</b>	3,
RH (8)	89	06	8 4	83	87	87	8.7	87	88	88	87	06	88	85	8]	 	ž	9.1	t ()	94	91	87	8.2	81	83	87	19	78	72	72	46	11	9/	75	6/	84
(m/sec)	•	•		•	•		•		•	•	•				•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	5.8	•	•
Date/"ime	19	/13 19	_	/13 20	/13 21	/13 21	/13 22	/13 22	/13 23	/13 23	/14 00	/14 00	/14 00	/14 01	/14 01	/14 03	. 11/	114 13	/14 03	/14 04	/14 04	/14 05	/14 05	/14 06	/14 06	/14 07	/14 08	/14 08	/14 09	/14 09	7	/14 1	/14 ]	12/14 1200	/14 12	/14 1

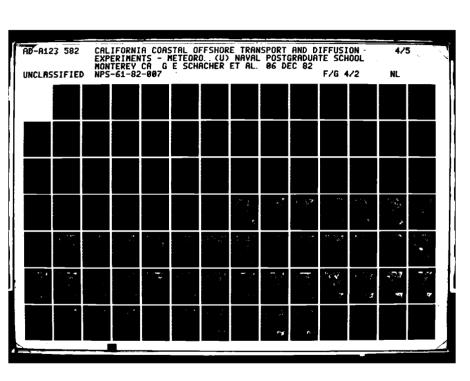
. ..

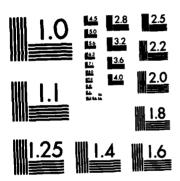
81,M 3 81 All Data

t (min)	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•		•	3.6	•	
(#/8cc)		•						•	•	•	•	•	٠	•	•	•		•		•	•		•	•	•	•	•	•	•	•	•		•	0.3		
2/F	. 510-0	.260-0	.24E-0	.84E-0	.32E-0	.55E-0	.61E-0	.51E-0	.02E-0	.71E-0	.81E-0	.8 2E-0	.18E-0	.22E-0	. 18E-0	.74E-0	.06E-0	.70E-0	4.05E-0	. 03E-0	1.62E-0	.89E-0	.56E-0	2.20E-0	2.25E-0	.76E-0	2.40E-0	4.46E-0	.95E-0	8.91E-0	.78E-0	.81E-0	.12E 0	-3.20E 00	2.96E 0	.26E 0
10+3*00 (m/secr)	20.	· π	12.	-5.	13.	6	42.	23.	16.	15.	16.	20.	31.	43.	35.	27.	20.	12.	0	5.	0	7	7	9	5.	9	3	6	20.	23.	30.	19.	23.	153.1	32.	26.
T**	. 112	0.02	0.01	0.01	0.01	.05	0.04	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.04	.03	0.02	0.01	0.00	00.	00.	.01	.03	.02	.03	.04	.02	.07	.10	.11	.11	. 10	.11	0.138	.11	. 11
(1)* (1)*	2.	.31	35	35	. 34	. 24	. 24	. 24	. 25	. 26	. 26	.22	.21	.20	. 19	.18	. 15	. 15	.23	.18	. 18	.26	.35	.37	.13	.17	. 11	. 14	. 14	. 12	. 14	. 13	.11	0.075	.07	.04
Z i (P)																																		09		
ns (C)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	12.5	•	•
T (C)	٠ · ٠ ۲	1 3.1	13.1	13.0	13.1	14.3	14.1	13.5	•	•	•	₩.	<u>.</u>	4.	3.	<u>.</u>	<u>.</u>	٠	5.	2.	2.	2.	_;	_;	_	•	•	•	•	•	•	•	•	9.3		10.1
RH (%)	47	× ~	90	9.1	9.1	8.4	85	88	30	91	91	90	8.7	85	98	8.7	88	8 9	93	95	92	96	16	98	43	96	95	63	95	96	61	96	95	95	95	90
(18/8ec)	7.1	6.3	1.1	٠		•	•	•	•	•	٠	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	2.2	•	1.3
Date/Fine	01/11/11/11	1.5711 15000	- +		7.4	12/14 1559	/14 1	/14	/14 1	/14 1	/14 1	/14 1	/14 ]	714	/14 1	/14 1	/14 1	/14 1	/14 1	/14 1	/14 1	/14 1	/14 2	/14 2	/14 2	/14 2	715 0	/15 (	/15	/15 0	/15	/15 0	/15 0	12/15 0330	7	abla

BLM 3 81 All Data

Nate/Pime	Ω		J,	S.	Zi	<b>*</b> 5	¥.L	0+3*0	z/L	*	Ħ
	(m/sec)	(* *	(3)	(0)	(m)	(m/sec)	(0)	(m/secK)		(m/sec)	(min)
715	2.	06		•	09	.07	.07	9	1.69E 0	•	•
$\leq$	4	64	•	•	09	. 13	05	7	3.95E-0	•	•
2/15 0600	7	9.5	11.6	•	09	.28	0.033		9	0,3	3,8
7.5	5.	9.5	•	•	09	91.	.04	χ,	2.23E-0	•	•
$\overline{}$	2.	96	•	•	09	.07	.08	4.	2.06E 0	•	•
<del>}</del>   7	-	<del>1</del> 6		•	6.0	90.	.07	8	2.468 0		•
_	-	<del>-</del>	•	٠	6.0	· 06	.07	~	2.42E 0	•	•
- : -	-	6.6	•	,	9	.05	.07	œ	3.00%	0.2	•
$\overline{}$	· .	35	•	c:	0.9	.07	07	4.	.906	•	
	4	ઝ્ઝ	•	•	09	. 12	.01	9	.125-0	•	•
- : : :	~	ক্	•	2	09	. 10	.01	•	.30E-0	0.0	•
	ci	88	; :	2	09	90•	00.		.83E-0		•
- - -	ý.	91	•	•	09	. 22	00.	4.	.18E-0		•
- - - -	æ.	06	3	7	09	.28	0.02	5.	.31E-0	•	•
<u>-</u>	9	<b>8</b> 8	3	2	09	. 22	0.03	7.	.78E-0	•	•
	•	11	4.	2	09	. 11	0.04	43.	.03E-0	•	•
_	•	6.3	9	2.	09	. 08	.08	7	,40E 0	•	
<u>-</u>	•	63	7.	2.	09	00•	0.00	2	.99E 0	•	•
<del>-</del>	•	09	7.	2.	09	00•	90.	5.	.88E 0		•
<b>₹</b>	•	77	4.	2.	09	• 19	0.04	40.	.32E-0	•	•
50.4	•	11	Š.	2	09	.20	0.06	61.	.71E-0	•	•
1.1	•	78	4.	2	09	. 24	0.06	6	.15E-0	•	•
	•	11	ŗ.	2	09	.23	90.	63.	.38E-0	•	•
-	•	79	•	· .	09	. 18	0.06	φ Ω	.99E-0	•	•
	•	75	•	5.	0 9	. 04	0.04	æ	.02E 0	•	•
		¥.			09	.00	0.00	<b>,</b>	0 366.		•
		<b>⊹</b>	•	2	09	.02	• 03	<b>φ</b>	.69E 0	•	•
	₹.	 T	•	<u>ن</u> ا	90	. 18	0.04	7.	.35E-0		
			•	÷	09	.10	• U 6	3,	.93E-0	•	•
					09	11	0.01	٠. د.	.36R-0	•	
		-		•	0.0	<u>.</u>		<b>*</b>	620-0	0.0	•
				•	U)	<u>ං</u>	<u> </u>		.268-0	•	•
			- -			. 13	0.		0-368	•	•
						• 05	.01	•	.06F-0	•	•
			©	12.6	09	0.026	-0.018	14.1	2.48E 00	0.0	0.0
			•	•		• 06	04	. •	.17E 0	•	•





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

BLM 3 81 All Data

t (min)	0.0	•	٠	•		•	•	•	•	•	•	•	•	•	. (	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
w* (m/sec)	0.0	•	•	•					•	•	•	•	•	•	• •		•			•	•	•	•	•	•	•		•	•	•	•		
z/L	0E 1.E	.87E 0	. 50E-0	99E 0	.99E 0	1.62E-0	.89E-0	3.56E-0	2.20E-0	.05E 0	.92E 0	. / 38 0	. 34E U	445-0	89E-0	.63E-0	.35E-0	.46E-0	.64E-0	.73E-0	.27E-0	. 2 3E -0	.32E-0	.39E-0	.47E-0	.64E-0	. 25E-0	.88E-0	.25E 0	.72E-0	.55E-0	.72E-0	.11E-0
10+3*Qo (m/secK)	-17.3 -28.5	25.	42	· ~	0	0	7.	7	•	19.	23.	23.	• •	25.	24.	8	37.	35.	28.	36.	33.	52.	58.	67.	41.	32.	41.	5.	4.	-	2	32.	33.
T* (C)	-0.020	0.02	0.04		0.00	00.	.01	.03	.02	0.02	0.02	0.02	0.02	פרי	0.03	0.05	0.05	0.04	0.04	.05	.04	• 06	.07	• 08	• 05	.04	• 05	• 05	.04	• 03	.03	.04	.04
U* (m/sec)	0.022	.03	.07		8	. 18	. 26	.35	.37	. 02	.03	• 04	. 03	000	080	. 13	.13	.17	.11	. 12	. 11	. 12	. 11	. 10	• 08	• 09	.12	.10	.05	.05	.07	• 00	.11
2 i (m)	09																																
Ts (C)	12.5	2.	, ,	, ,	7	7	2	2.	5	2	2	N	,	,,		2	7	2.	2	2.	5	5	2.	2	2	2.	2	2.	2.	2	2.	2.	٠.
٦ (٢)	14.4	14.5	•	14.6	• •	•	•		Ϊ.	4	4.	<b>4</b> (		•	,	4	4	4.	4.	4	4.		δ.	•	5	4.	2	2.	2	4.	14.4	14.7	14.5
RH (*)	72	73	73	0 4 7	72	92	96	97	86	72	74	7.7	ر د د	7 0	62	63	99	99	62	19	62	28	54	20	26	59	52	21	48	09	63	99	73
U (m/sec)	2.1	•	•	•		•	•	•	•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Nate/Time	12/16 0230 12/16 0251	716 03	716 03	716 04	/16 04	/14 19	/14 19	/14 20	2/14 21	2/16 05	/16 05	2/16 05 2/16 05	2/16 06	90 91/	2/16 07	/16 07	2/16 07	2/16 08	2/16 08	/16 09	/16 09	/16 09	/16 10	/16 10	/16 10	/16 11	/16 11	/16 11	/16 11	/16 12	/16 12	/16 12	/16 12

BLM 3 81 All Data

hate/Pime	Ω	RH	<u>:</u> -	r.s	2 i	*11	* t	10+3*00	z/ľ.	* 3	٠٠
	(11/2GC)	(	(0)	(0)	(E)	(m/sec)	(0)	aS/n		(zos/z)	(min)
12/15 1314	0.6	76	14.5	٣,	09	.20	0.04	35.	. 0380		•
12/16 1329	10.6	77	14.4	3,	09	. 26	.04	ی	.40E-0	•	•
12/16 1400		40	•	<u>ج</u>	09	. 24	0.02	15.	.25E-0	•	
1 91/		81	•	د	09	.22	0.02	11.	.69E-0		•
/16 1	•	83	•	۳,	09	.21	0.01	•	.72E-0		•
/16 1		84	•	ς,	09	.20	.01	0	.04E-0		•
/16 1		98	•	<del>.</del>	09	.20	0.01	6	.89E-0		•
/16 1		35	•	ن	09	.21	.01	10.	.69E-0	•	•
	5.8	84	13.7	13.2	9	0.213	0	-12.9	3.44E-02	0.0	0.0
/16 1		83	۳,	3	09	.23	.01	7.	.67E-0	•	•
/16 1	•	83	4	3	9	.25	.02	4.	.76E-0	•	•
/16 1		79	4	3,	09	. 32	0.03	25.	.81E-0		•
/16 1	•	9/	4.	<del>.</del>	09	.22	0.03	25.	.12E-0	•	•
/16 2		71	•	۳,	09	.19	.04	7	.01E-0		•
/16 2	•	70	4.	₩,	09	.14	0.03	7.	.05E-0	•	·
/11	•	99	•	<del>.</del>	09	. 10	00.		. 28 E-0	•	•
/11	•	72	•	÷.	09	.24	.01	_;	.13E-0	•	•
117	•	75	•	3.	09	• 06	.01	0	.52E-0	•	•
/17 1	•	77	•	ж •	09	.08	.00	~	.186-0		6
$\subseteq$		7.5	•	٠,	09	.10	00.0	0	1.19E-0	•	•
117 1		11	•	<b>.</b>	90	.08	00.	~	6.038-0	•	æ
12/17 1130	•	79	•	3.	c	.08	00.0	٠	1.118-0		4
<		Ç.	•	·	120	.07	=	•	.748-0	•	•
1171	•	32	•	÷	7	.02	00.	7	2.906.0	•	ς.
/17 13	•	H 4	•	~	2	• 05	.01	ි. ස	.37E 0	•	·
/17 1	•	82	•	4.	$\sim$	90.	.02	2	.31E-0		9
/17 1	•	80	•	4.	ᠬ	. 11	.02	<b>ф</b>	.68E-0	•	4.
/1.1		83	•	4.	œ	.09	.01	9	. 4 3E 0	•	5
/17 1	•	85	•	<del>.</del>	œ	.09	00.	7	.61E-0	•	8
/17 1	•	9/		ъ.	$\boldsymbol{\infty}$	.05	0.00	•	.51E-0	•	•
/17 1		9/	•	۳,	09	.04	0.01	•	• 0 5E-0	•	ó
7		82	•	۳,	80	.08	00.	•	.50E-0	•	۳,
/17 1	•	84	•	<u>ج</u>	6	.07	• 00	•	.12E-0	•	9
/17 1	•	68	•	3,	$\sim$	.03	90.	•	73E 0	•	0
12/17 1800	4.8	91		13.4	120	.04	00	4.	.01E 0	•	•
/17 18	•	88	•		9	.03	00.	•	.08E-0		•

MLM 3 81 All Data

Date/Time	<b>=</b> (		E (	S.	z i	_ ⊃ `	# (	÷,	z/L	33 (	1
	(m/sec)	( <del>g</del> )	(3)	<u></u>	(E)	(m/sec)	(3)			(m/sec)	(ale)
/11/	4	85	13.5	m	240	.02	90	2	.98E 0	•	•
2/17 1930	1,8	83	13.4	12.7	280	0.040	-0.014	8-6-	7.25E-01	0.0	0.0
111	_	11	•	~	200	.02	.01	•	.8 3E-0	•	•
2/17		75		2	160	. 02	.01	•	.78E 0	•	
/11/	4	78	~	m	140	.12	.02	3,	. 03E-0	•	•
2/17	2	11	4	•	140	. 15	.02	æ	.84E-0		•
2/117	9	80	•		09	. 19	.02	•	.76E-0	•	•
2/17	9	84	۳,	•	200	.21	.01	6	60E-0	•	
/117	7	89	8		300	.23	.01	4.	.02E-0	•	
11	<b>∞</b>	92	•		170	. 32	.01	2	.48E-0	•	
718	œ	93	_;	•	170	.30	.03	ω,	.52E-0	•	•
~ \ \	6	94	•	~	170	.35	.04	ς.	. 66E-0	•	•
	]	4.7	١٦. ٥		150	.37	.04	_	.25E-0	•	•
7	10	95		~	150	.34	. 04	ĸ,	.35E-0		
=======================================	=	95	_	3	250	.27	.04	S,	.97E-0		•
<u>~</u>	œ	95	•	4	250	.26	90.	e.	1.22E-0		•
/18	œ	94	•		250	.26	90.	4.	.23E-0		•
78	7	63	-		250	.22	.05	Ŋ,	. 49E-0	•	٠
/18	7	92	֡֡֡֡֡֡֡֡֡	•	250	.23	.02	4	.35E-0	•	-
7	7	92			250	.25	.02	•	91E-0	•	•
7.8	7	16	2.	•	250	. 22	.03	2	.74E-0		0
718	7	8 9	2.		250	.24	.01	9	.26E-0	•	4
/18	e	06	•	•	250	.25	.01	æ,	.49E-0		4
/18	7	89			250	.20	.01	7.	.86E-0		m
/18	7	87	2	•	250	.21	. 02	6	.62E-0		

Measured and calculated meteorological paramenters for BLM-4. Table 8d.

BLM-4 1982 All Data

t (min)	000	4 c. 1	•			L)	•	္	•	) - - -	• •	٠ ان ا	S.	36.6	5.	•	•	•	•	•	•	ر د.		•	٠. د.	•	ت. د	0.0	•	•		•
(m/sec)	000	o e.	•	•	0.0	•	•	•	•	•			٦.	•				•	•			•	o.0	•					•			•
z/L	24E 60E-	. 8 3E-0 . 16E-0	.10E-0	0-388°	.58E-0	.56E-0	1.728-0	.156-0	.47E-C	0-304.	. 16e-6	.40E-0	. 04E-0	8.16E-0	3.25E-0	. 366-0	.15E-U	.82E 0	.27E	.55E U	.158 0	·63E-0	71:-0	. 33E-U	ż.	.12E-0	-397.	.30	-790·	.52E-	<u>ت</u>	.29E
10+3*Vo (n/seck)	-21.1	7	<b>;</b>	•	9-	Ġ	4.	2	عر	•	, ,		•	ċ	4.	ů	5.	Ġ	•	ż	<del>.</del>	<b>:</b>	•	ઙ૽	5.	۲,	.7		4.	ş.		<del>.</del>
T. (C)		-0.036	00	25	33	00	00	00	3	70	00	5	00	62	03	13	02	30	7	03	04	S	C 5	5	-0.045	. 04	.04	-0.040	.03	.03	02	. 61
(m/sec)	0.033	.14	.20		12	.11	.10	. 14	83 c		65	90	. 08	• 06	.12	• 06	80	.00	.61	. C4	99.	.10	.12	. 14	7	.12	.16	. 08	.07	. 08	Ö	.11
Z i (m)	750	വ	S	വ	S)	0	0	0	$\circ$	<b>3</b> C	S	0	0	2	S	S	'n	T)	~	4	4	9	2	0	S	9	1	7	1	O	0	0
rs (C)		12.6	•	•	•	•	•	•	<u>.</u>		2	7	3	2	m	2	:	2	2	2	5	5	2	3	7	5	5	3	5	5	ä	2
T. (C)			3	25	7	3	2.	÷ (	, c	, ,	2	(4	.,	3	2	<del>.</del>	ش	4.	4.	4.	4.	4.	4.	4	4.	4.	4.	4.	4.	3.	3	5
KH (♣)	92	8 1 0	33	သ သ	2.5	91	26	£ (	<b>3</b> (3)	700	1.5	65	25	66	<u> 6</u>	<u> </u>	99	6.4	ε1	£3	82	g 3	84	6.4	.o	၁	87	23	86	68	ეე ე	94
U (IIV/Sec.)	2.4	• •	•	•		•	•	•	•	•			•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•
Date∕rime	0000	0130	0200	0230	0330	0400	0430	0500	0530	0000	0.000	0730	0800	0830	0935	1030	1100	1130	1200	1230	1300	1330	1400	1430	1500	1530	1600	1630	$\supset$	3	1630	$\sim$
Date/	11	00/21	06/21	2 5	06/21	2	06/21	7	06/21		06/21	~	UU/21	06/21	(io/2]	Co/21	06/2]	\			06/21	`	06/21	\	( 6/2]	06/21	06/21	06/2]	06/2]	06/21	c5/21	u6/21

BLM-4 1982 All Data

BLM-4 1982 All Data

(min)	•	J. ()	•	٠. د	•		•	၁·၁	•	0.0	•	•	•	•	•	ر <del>م</del>	က်	7	پ	•	<b>.</b>	5.	•	•		•	ŝ	3"	ري. د	5.	٠,٧	.,	4.	24.5	.;	9
(m/sec)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•			•	•		•	•	•	•	•	•	0.4	•	0.4
2/L	31E-0	.38E-0	.66E-Ü	. 87E-0	.64E-0	.50E-0	.8 5E-0	.87E-0	.54E-U	.588-0	. Ule-0	. 09E-U	0-A99.	.71E-0	. U4E-0	.71E-U	.14E U	.14r-ù	. 43E-0	·31F-0	. 15E ú	.59E-U	.50E-0	.58E 0	. 90E 0	.61E-0	.86E-0	.25E-0	.64E-U	.75E-0	.75E-6	.22E-0	. 48E-U	•	0-350.	٥.
10+3*Jo (m/sech)	64.	67.	4.	54.	42.	32.	25.	19.	ŝ	12.	٠.	7.	ж ж	و	3	3	-	å	5.	å	<b>.</b>	ę.	?		6.	11.	5.	'n	'n,	ċ.	.;	'n	~	23.2	<del>ر</del>	œ;
T* (C)		0	•	<u>.</u>	•	j	•	•	•	ċ	•	•	-0.013	-0.013	•	0.007	•	•	•	0.010	•	•	•	•	0	•	0.007	•	•	•	•	0.016	•	0.019	•	0.618
(n/sec)	.18	.13	.12	.13	.11	9	.10	. u9	90.	93.	. 07	.64	.05	. 04	. 06	.07	90.	.03	.05	.05	.04	.14	.09	90.	.00	.23	.17	.16	.09	.18	.19	.19	.19	0.154	.13	.13
2 j	009	600	009	009	009	009	600	575	260	620	5 40	6 20	630	630	630	6 20	590	550	550	009	620	550	550	460	450	510	400	350	300	260	420	500	009	550	400	550
T's (C)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	~	3	÷.	ö	2	<del>.</del>	ä	m	÷	2.	12.6	7	•		•	•	•		•	12.5	13.2	13.2
Ţ. (C)	5.	Š	5.	4.	4.	8	<del>ب</del>	3.	<del>ب</del>	ж •	3	2	2.	.7	Š	2	į,	ς.	.;	۳,	<del>.</del>	<del>.</del>	4.	5.	÷.	3,	3	۳,	3,	2	3.	2	2	12.3	7	2
EEE (%)	11	11	78	7,2	82	85	86	87	S S	z s	K S	90	90	ى ك	91	93	<u>.</u>	ر 4	43	R P	α α	92	O A	14	73	<b>3</b>	6.5	رد در	53	91	9.5	y i	96	97	25	9.4
(m/sec)	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•		•	•	•	•	•	•	•		•	•	•	•	•		9.9	•	•
Date/Time	1600	1630	1700	1730	1800	1830	0061	1930	2000	2030	7100	2130	2200	2230	2300	2330	0030	0330	0060	1020	1050	1204	1234	1444	1524	2034	2140	2210	2337	0007	0158	0228	0401	0431	0526	064 ស
bate,	.7			7	?	7			2	00/22	~	N		.\		$\sim$	7	N	N	7	?		06/23		N	00/23	u6/23	00/23	06/23	06/24		7	00/24		00/24	06/24

BLM-4 1982 All Data

t (min)	27.2	)		o.0			ာ ၁	•	•		•	9.	•	٦. ص	•	•	ာ ဂ	•	o.0		ာ ၁	ာ ၁	၁ ၁	၁ •	•	ر. د	J. O	J. O	•	ာ ၁	ر. د	ပ ပ		o. o	O.0	o. c
W# (m/sec)	0.3		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•
7/2	9F-C	. 34E-	.23E-0	.20E-0	.582-0	. 11E-0	.92E-0	. 30E-Ü	.29E-0	. 10E-0	.79E-0	.26E-0	.11E-0	.46E-0	.48L-G	.57E-0	. 86E-0	.09E-6	·53E-0	.70E-0	.37E-0	. 676-0	.94E-0	.47E-0	.16L-U	.90E-0	.54E-0	. 12E-0	.68E-0	·61E-0	.31E U	.24E 0	.43E 0	35E U	. 39L U	. 99E 0
10+3*Uo (m/seck)	~	-7.2	9	13.	;	5.	14.	2	20.	-5. K	•	•	•	•	•	-7.7	12.		13.	•	•	-32.5	28.	•			32.			•			17.	-1.2	<b>:</b>	•
T.* (C)	$\neg$	0	~	0.01	.01	.01	0.01	0.02	0.02	01	.00	9	.01	0.01	0.01	0.01	.02	0.02	.02	0.02	.03	63	.03	.01	00,	70,	03	.03	၉၅	.03	.03	സ	. Ul	3.	-0.000	-0.000
U* (m/sec)	.11	0.061	90.	. 08	.07	.07	• 09	.16	.14	.11	.15	.20	.21	.20	.19	.19	.19	.19	. 21	.24	. 28	. 25	.22	.19	.20	.19	.14	.10	.12	.07	.04	.04	. 62	.00	00.	00.
Zi (m)	200	4 50	460	460	200	200	200	200	200	200	200	200	550	550	550	550	550	550	250	550	550	550	009	009	009	009	009	700	700	750	600	008	800	820	8 20	820
(C)	13.5	12.7	12.8	12.8		13.1	13.0	14.0	14.1	14.4	14.4	14.3	14.4	14.3	4.	4.	4.	4.	4.	4.	<del>.</del>	13.1	÷	<del>.</del>	<del>.</del>	5	2.	;	2.	.7	;	-	-	11.8	•	•
T. (C)	13.1	13.1		٠ س	<u>«</u>	۳,	۳.	4.	5.	5.	4.	4.	5.	Ş.	5.	5	5.	Š	رۍ	4.	4.	4.	<del>.</del>	<del>ر</del>	<del>ب</del>	۳,	۳.	<del>.</del>	3.	<u>.</u>	4.	٠. ٣	<del>.</del>	13.8	4.	3
KH (%)	91	91	ერ	0.6	63	67	90	82	13	к3	84	98	83	α 3	84	က <b>ဘ</b>	Ŕ3	64	85	ر د ر	ລຸ	<b>ઝ</b>	ე	£5	94	45	93	94	53	: '2	£.5	7.3	63	ξS	3	7.3
(m/sec)	•	2.3	•	•	٠	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Time.		0830	-23	2	$\circ$	<b>_</b>	_	$\alpha$	~	$\sim$	4	4	S	2	9	•	7		·×	သ	2	2	0		_	_	N	: `1	(7)	ഹ	$\circ$	9	Э	0130	Э	~
bate/Time		00/24		?			2		\	2	>	7	?		7	`		7	0/5		2	(16/24	7	?	6/2	"	7/7	7/	7	7	5/2	7.	7	00/25	N	

JLM-4 1982 All Data

t (min)	•	0.0	•	•	٠	•	•	•	•		•	•	•	•	•		•		•	•	•	•	•		•	•	•	•	•	•	•	•	•	၁ • ၀		•
w* (m/sec)	•	0.0	•	•	٠	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
z/L	.24E-0	<b>-385</b>	.92E-0	.58E-0	.15E U	.15E 0	.02E 0	.43E 0	.28E-0	.66E-0	.76E-U	.81E-0	. 06E 0	.99E 0	.49E 0	.59E 0	.72E-0	.64E-0	.12E-0	.39E-0	. 65E-0	.86E-0	.40E-0	. 18E-0	. 70E-C	.291-0	.67E-U	.50E-0	.28E-0	.87E-0	.996-0	.10E-0	. o ot-0	.84E-0	.97E-0	23E-0
10+3*QO (m/seck)	13.	-20.8	22.	17.	;	13.	٥	31.	34.	3	40.	÷	10.	4	Ġ	5.	5.	u)	ထံ	9	62.	62.	68.	ж ж	gj.	4.	<u>.</u>	у В	4.	16.	134.	33.	96.	101.	37.	111.
ř. (C)	.01	-0.025	.62	.02	.01	.01	.02	0.03	0.04	.04	.04	05	.01	0.00	00	.07	• 09	. 68	.08	.07	• 06	90	.07	.08	. 68	.08	.09	60.	10	. 11	.13	. 13	.10	5	. 13	0.1¢
U* (m/sec)	.05	0.126	.09		.03	.03	.02	.05	.11	.15	.16	. 09	.00	00.	90.	.07	.17	.19	.21	.23	.27	.32	.38	.38	. 4 ]	.37	.37	.39	. 44	. 45	. 44	.37	.39	200	.42	. 55
Z i (m)	820	820	750	700	200	740	740	730	740	740	650	200	450	450	4 50	400	380	320	300	200	250	210	220	180	150	150	150	150	250	320	330	400	320	100	100	100
÷s (С)	<u>ب</u>	13.0	۳,	۳,	<del>.</del>	ندا	5	2	۳,	پ	2	2	2	~	3	2	3	5	2	2	2	ς.	?	2.	2.	5	2	2.	÷	<del>.</del>	ij	7	2	8.01	္	0
r (C)	ω.	14.0	4.	4.	4.	4.	4.	4.	4.	4.	4.	ŝ	Ġ		-	9	Š	5.	Š.	ů,	5	5.	ς.	5.	5.	5	Š	5.	5	5.	ė	ۍ.	3	÷	Ġ,	က်
( %) ( %)	9	87	23	8 8	67	ъ4 4	82	82	<b>13</b>	) Q	βO	11	.0	64	64	70	74	9/	78	90	8.2	ж Э	82	82	8 3	35	82	χ, <b>α</b>	S ()	11	76	1.1	81	94	56	ي ئ
U (m/sec)		4.3																						0	~	10.4	$\odot$	<b>:</b>	2	.7	∻;	3	<b>:</b>	11.6	7	4.
rime	0300	0330	0400	6430	0200	0530	0090	0630	0029	0730	០១ឧ១	0830	0060	0330	1000	1030	1100	1136	1200	1230	1300	1330	1400	1430	1500	1530	1600	1630	1700	1730	1800	1830	1913	1130	$\sim$	~
bate/Time	00/25	. \	00/25	7	7	7	7	$\sim$	?	7	7	7	~	?	~	7	7	?	2	7	7	$\sim$	7	?	2		2	$\sim$	7.	?	Uo/25		06/25	17/00		7

BLM-4 1982 All Data

2.1

BLM-4 1982 All Data

vate,	vate/rime	u (m/sec)	KII (&)	÷ ()	£3.	2 i (m)	U* (m/sec)	,,,,(C)	10+3*UC (m/secK)	П/2	(m/sec)	t (min)
06/28	0930	•	94	3	-	099	69•	.04	0	(1)	0.0	3.3
	1000	5.3	93	13.6	11.7	099	0.150	-0.052	-54.5	i	0.0	J.0
06/28	1030	•	35	۳,	÷	099	. 23	.67	£3.	.82E-	0.0	•
?	1160	•	94	4.	;	099	.18	.07	ಏ	·63E	•	n.0
	1130	•	94	4.	;	700	.11	90.	99	.50r-	•	•
06/28	1300	•	92	4	;	800	.15	.07	4.	. 96	•	•
66/28	1330	•	93	δ.	-	800	.19	.08	<b>ස</b>	.85E-0	•	•
U0/28	1400	•	63	ۍ.	7	800	.17	.08	90.	36	0.0	<b>.</b>
7	1430	•	92	5.	;	850	.18	.09	•	.546-0	•	•
	1500	•	32	5.	7	850	.17	.09	97.	.77E-0	•	•
`		•	76	Š	7	850	.20	• n •	104.	.93E-0	•	•
06/28	1600	•	92	5.	;	850	. 25	.10	112.	.99E-Ú	•	•
7	1630	•	35	5.	;	8 50	. 25	.10	16.	.20£-	•	٠ ت
7	1700	•	94	5.	;	850	.23	.09	07.	.29E-	•	•
.~	1730	•	94	4.	;	820	.21	30.	.'	·63E-	•	•
?	1800	•	35	4	ä	850	.24	.08	94.	.91E-	•	၁ ၁
7	1830	•	94	4.	4	850	. 26	• 05	Ś	.73E-	•	•
`	1900	•	94	4	;	8 50	. 26	. 09	98.	•	•	•
7.	0800	•	94	<del>.</del>	ij	3000	90•	.63	÷.	. 01E	•	•
CV.	0830	•	96	<b>ب</b>	;	3000	09	.04	7	• 94E−	•	•
06/29	0969	•	95	<del>.</del>	;	3000	90•	.03	7.	.24E	•	•
	0930	•	96	ë.	;	3000	. 65	-0.633	•	· 3oE	•	
7	1000	•	54	ω,	<b>;</b>	3000	.03	<b>.</b> 63	<b>:</b>	.57E	•	٠
7.	1030	•	25	4.	÷	3000	<b>.</b> 09	90.	68.	.59E-	•	•
?	1200	•	7.6	5.	2	3000	. 0a	9	•	. 19E	•	•
?	1236	•	ر د ا	5	?	3000	90•	• 06	2	.6 EE	•	•
7	1300	•	<b>0</b> 6	Š.	2	3000	90.	G	<u>.</u>	. d1E		•
7/	1330	•	95	٠.	2	3000	.10	. 65	4.	-06t-	•	•
<b>v</b> 6/29	$\overline{}$	•	4.0	5.	2	3000	.08	S	7	.71t-	o.0	٠ ت
7.	1430	•	£6	<u>ۍ</u>	2	3008	. 67	.05	4.	.23E U	•	•
1/2	1500	•	y s	5	3	3000	0.	درج	55.5	.82E U	•	•
Uú/29	1530	•	い	4	2	3000	.07	S	•	٣.	•	•
	$\supset$	•	<u>ئ</u> ز	4.	3	3000	.16	• 05	4.	. 44Li-	•	ر د د
-	3	•		~ ~	<b>.</b>	3000	14	.05	5	<b>ယ</b>	•	•
62/04	1700	•	66	۳,	;		٠ •	S	-56.5	80	ວ.ວ	J • Ü
-	ر د ،	ن. ن. د		۳.	]:	30 00	. 04	• 03	38.	• 4	•	•

BLM-4 1982 All Data

Late/Pine		Red	÷	ទ	źż	* *	¥,Ť	10+3*00	z/L	*	. بد
1. 2. 1. 2. 1. 4.	(m/sec)	(%)	(0)	(0)	(=)	(m/sec)	(3)	(III/Secv)		(m/sec)	(u T u)
78	2	15	13.7	11.7	3000	0.026	-0.023	-24.7	4	•	J. Ú
/30 06	<b>3</b>	25	14.4	15.0	3000	•	•	26.5	.5	•	59.0
60/30 6722	<b>3</b>	35	•	•	600	0.257	00.	J.0-	0	•	0
/30 09	Ġ.	75	5	•	009	•	•	-63.5	-499.	•	၁.၀
/30 10	9	83	5.	•	088	•	•	ت	.2	•	၁ ၁
/50 10	9	90	5	•	880	•	-0.054	3	.62E-0	•	J.O
/30 12	4	3.6	9	•	880	0.061	•	-33.1	. C7E 0	•	ن. ت
/30 13	7.	93	3	•	ងមហ	•	•	_	•	•	ر د د
/30 13	7.	85	5	•	083	0.191	•	•		•	ر. ت
/30 15	,	25	5	•	០នន	•	•	-91.7	.75E-	•	ວ ວ
/30 15	ω	<b>ا</b> ئ	'n	•	006	•	•	_	.45E-	•	ာ ၁
/30 16	3	51	5	•	006	•	•	_	3	•	ງ • :ງ
30 17	10.	27.	15.4	12.6	005	0.322	-0.091	<b>~</b>	.13E-0	•	J.0
30 17	S,	54	3	•	006	•	•		. 0 9E-0	•	၁ • ၁
7	ж ж	54	5.	•	006	0.217		-114.4	.88E-0	•	
30 20	7	100	4.	•	750	•	•		0-33ª.	•	J.O
36 20	ж •	0	4.	•	750	0.233		•	.20L-0	•	•
30 22	<b>2</b>	9	4	•	700	•		6	· 63E-0	•	74.7
30 23	8	ာ	4.	•	200	•	•	Ď,	•61E-0	•	, i
01 05	7.	160	2	•	780	•	-0.035	-38.3	.30E-0	•	ر د د
01 UB	2.	63	5.	•	780	•	•	•	. 99E O	•	J. J
01 08	2.	89	5.	•	580	•	-0.002	•	0 A66.	•	o. c
01 09	ж Ж	16	ις)	•	440	•	•	۲,	.97E-0	•	ာ ၁
בי זרי	6	25	4.	•	290	•	٠	<del>رم</del>		•	၁ · ဂ
11 10	10.	93	5	•	400	•	-0.038	•	.34E-0	•	
01 13	11.	95	5	•	400	•	0.	7.2	.80 E-0	•	25.8
01 13	10.	55	Ś	15.1	200	•	-0.010	ж Э	•	0.0	ာ ၁
07/01 1452	1 1	£2	15.7	15.0	200	0.384	-6.023	-21.4	. 75E-U	•	o • o
01 15	14.	94	•	15.7	400	•	0.010	14.6	-6.31E-03	0.4	]0.2

## IV-5. Wind Direction Variance

Transport of material in the atmosphere is mainly accomplished by wind advection. The mean wind, averaged over some suitably long time, determines the centerline trajectory of a plume. The fluctuation of the wind about the mean determines the spread of a plume about the centerline.

It is not obvious what averaging periods should be used to determine mean wind. The division between what is considered average behavior and what is considered to be fluctuation is not clear, and in fact depends on the application for which a particular data set is to be used. The basic purpose of the data gathered in these experiments is to parameterize a one-hour average Gaussian model. Thus, the data presented in this section is one-hour average wind direction, and the variance about that average for the one-hour period. These data are presented in Table 9.

Table 9a. One-hour average wind directions, wind direction variances and the number of 10 sec. wind averages for BLM-1.

BLM-1: HOURLY AVERAGE WIND DIRECTIONS & SIGMAS

DATE	TIME PERIOD	<dir></dir>	SIGMA	N
09/23/80	1612-1717	257.4	9.5	228
09/24/80	1109-1205	231.1	13.3	192
09/24/80	1206-1301	230.6	12.9	190
09/24/80	1303-1357	252.4	11.5	189
09/24/80	1358-1453	261.5	7.7	189
09/24/80	1455-1549	253.7	8.0	186
09/24/80	1551-1645	262.0	7.1	187
09/24/80	1743-1837	274.6	6.0	164
	2: :0 2007	2/4.0	0.0	104
09/27/80	0647-0743	43.0	6.3	186
09/27/80	0917-1013	278.5	10.2	207
09/27/80	1110-1206	270.4	6.6	208
09/27/80	1207-1302	274.3	5.6	201
09/27/80	1303-1358	273.0	4.7	200
09/27/80	1359-1454	272.1	4.0	200
09/27/80	1456-1550	274.5	2.4	198
09/27/80	1551-1646	273.2	2.9	200
09/27/80	1647-1742	268.3	2.8	199
09/27/80	1744-1838	268.7	3.6	196
			3.0	190
09/28/80	1239-1335	231.0	10.3	207
09/28/80	1340-1436	247.1	7.8	208
09/28/80	1437-1532	256.6	7.4	200
09/28/80	1534-1628	253.4	4.9	198
09/28/80	1712-1808	260.4	4.4	207
09/28/80	1809-1904	256.7	4.5	198
				-,-
09/29/80	1149-1245	229.3	5.1	219
09/29/80	1251-1347	252.7	5.0	216
09/29/80	1349-1443	262.4	3.3	212
09/29/80	1444-1540	261.4	3.9	162
09/29/80	1558-1654	266.0	2.4	218
09/29/80	1656-1750	268.4	5.2	211
09/29/80	1751-1846	285.0	3.8	211

Table 9b. One-hour average wind directions, wind direction variances and the and the number of 10 sec. wind averages for BLM-2.

DT M-2 .	HOURT.V	AVERAGE	WIND	DIRECTIONS	S.	SIGMAS
RT.M-2:	HOURLY	AVERAGE	MIND	DIVICITORD	•••	

DATE	TIME PERIOD	<dir></dir>	SIGMA	N
01/06/81	1125-1225	289.3	13.7	217
01/06/81	1325-1425	296.9	11.6	224
01/06/81	1425-1542	291.8	22.6	223
	1542-1642	301.2	13.3	221
01/06/81	1642-1742	279.0	9.5	2 20
01/06/81	1742-1842	280.7	17.1	220
01/06/81	1842-1942	341.6	50.7	220
01/06/81	1045-1345	5.25		
01/07/81	1132-1232	158.3	5.0	220
01/07/81	1250-1350	221.5	19.5	222
01/07/81	1350-1450	232.8	30.1	220
01/0//01				
01/09/81	1119-1221	278.0	10.6	221
01/09/81	1239-1339	273.1	6.7	220
01/09/81	1339-1439	281.4	3.4	220
01/09/81	1440-1539	278.9	4.8	218
01/09/81	1540-1639	276.0	9.2	218
	1640-1739	271.8	3.1	216
01/09/81	1040, 1133			
01/13/81	0822-0948	11.0	21.1	253
01/13/81	1019-1119	299.3	11.2	251
01/13/81	1209-1309	298.2	5.6	255
01/13/01	1310-1409	287.0	5.9	252
01/13/81	1409-1509	271.0	11.8	253
01/13/81	1509-1559	254.6	7.4	177
01/13/81	1559-1659	239.8	8.6	252
01/13/81	1223-1022	2000-		
01/14/81	1100-1200	180.7	46.5	255
J1/14/81	1200-1300	212.8	23.6	253
01/14/81	1300-1400	194.2	15.6	253
01/14/81		245.6	22.6	252
01/14/01				
01/15/81	1411-1500	203.6	17.3	210
01/15/81		282.1	32.7	257
01/15/81		289.1	6.5	252
•		244 2	127	249
01/16/81	0908-1008	344.3	12.7	
01/16/81	1020-1120	323.5	5.6	254
01/16/81	1120-1220	335.8	6.2	253
01/16/81	1220-1320	334.6	8.9	252
01/16/81	1320-1420	319.1	17.7	251
01/16/81	1420-1520	297.5	4.6	141
01/16/81	1520-1620	294.9	4.3	250
01/16/83	1621-1720	294.8	4.8	250
01/16/8	1721-1820	294.1	8.0	251
01/16/8		298.8	6.8	251
01/16/8		270.7	53.2	250
01/16/8		194.9	44.3	250
01/16/8		276.6	8.8	252
~ _ / ~ ~/ ·	-			

Table 9c. One-hour average wind directions, wind direction variances and the number of 10 sec. wind averages for BLM-3.

				0 - 013440
3:	HOURLY AVERAGE			
DATE	TIME PERIOD	<dir></dir>	SIGMA	<u> </u>
12/08/81	1222-1322	283.5	51.7	250
12/08/81	1323-1422	253.4	8.1	261
12/08/91	1422-1522	264.3	9.3	263
12/08/91		279.7	42.0	264
12/03/81	1523-1722	279.5		
12/08/31	1723-1822	196.6		
12/03/81	1325-1922	122.9		
12/03/91	1923-2022	110.7	6.4	262
12/03/91	2023-2122	32.2	20.3	262
12/08/91	2123-2222	176.3	40.2	262
12/09/81	2223-2322	214.0	27.7	262
12/08/81	2323-0022	208.8	33.1	262
12/09/81		275.1	37.1	262
12/09/81	0123-0222	48.6	70.1	262
12/09/31	0223-0322	159.1	41.2	261
12/09/81	0323-0422	120.6		
12/09/81	0423-0522	147.0	32.9	261
12/09/31	0523-0622	197.1	49.7	261
12/09/81	0623-0722	209.7	36.1	261
12/09/81	0723-0822	129.5		260
12/09/81		172.4	16.4	262
12/09/81		132.3	35.3	259
12/09/81		205.3		
12/09/81		199.5		
		173.8	9.3	264
12/09/81	1322-1422	151.6	12.3	262
12/09/81	1422-1522	94.8	35.0	263
12/09/81	1522-1622	64.9	10.1	263
12/09/81	1622-1722	80.3	9.5	263
12/09/81		114.3	15.6	262
12/09/81		113.1	12.7	263
12/09/81		105.4	26.3	253
12/09/81		252.3		264
12/09/31		350.4	25.3	264
12/09/81		55.6	11.6	262
12/09/31			16.3	262
12/09/91		24.4		
12/10/81	0023-0122	51.4	10.3	252
12/10/31	0123-0222	55.5	11.5	262
12/10/81	0223-0322	35.3	29.3	262
12/10/81	0323-0422	33.2	13.3	26 2
12/10/31	0423-0522	315.9	13.5	262
12/10/81	0523-0622	312.5	5.0	262
12/10/81	0623-0722	312.6	7.1	252
12/10/31	0723-0322	303.0	5.2	262
12/10/81	0823-0922	90.5	51.5	24.9
12/10/31	0923-1022	113.1	26.2	261

				a . a.a.v.).a
PLM- 3:	HOURLY AVERAGE			
DATE	TIME PERIOD	<dir></dir>	SIGMA	N
12/10/31	1023-1122	143.2 157.3	14.5	262 166
12/10/81	1123-1222			
12/10/81	1223-1322	153.6	37.1	262
12/10/81	1323-1422	23.8	46.5	261
12/10/81	1423-1522	312.6	18.9	261
12/10/81	1523-1622	28.4	44.5	
12/10/81	1623-1722	16.9		
12/10/81	1916-2016	20.0	19.2	263
12/10/31	1946-2046	15.7	16.5	262
12/10/31	2100-2200	42.3	9.0	268
12/10/81	2201-2300	7.2	20.7	261
12/10/81	2300-0000	345.7	11.5	265
12/11/81	0000-0100	358.3	16.2	265
12/11/81	0100-0200	13.0	13.1	264
12/11/91	0200-0300	49.0	12.0	264
12/11/81	0300-0400	52.0	15.5	263
12/11/31	0400-0500	11.4	24.8	263
12/11/81	0500-0600	350.0	12.0	264
12/11/81	0600-0700	346.4	5.6	265
12/11/81	0700-0800	17.9	24.2	263
12/11/81	0800-0900	56.6	11.9	26 3
12/11/81	0901-1000	65.0	39.6	255
12/11/81	1001-1100	120.4	38.9	248
12/11/81	1101-1200	240.6	16.5	24 9
12/11/81	1201-1300	256.8	16.1	249
12/11/81	1301-1400	272.5	7.9	248
12/11/91	1400-1500	285.0	5.1	249
12/11/81	1501-1600	232.6	3.2	243
12/11/91	1603-1657	235.7	2.9	226
12/11/81	1657-1751	291.9	2.3	224
12/11/91	1752-1845	295.7	2.9	223
12/11/81	1846-1939	325.6	46.1	223
12/11/81	1913-2006	39.5	63.0	223
12/13/81	0731-0831	71.3	22.3	247
12/13/81	0832-0928	59.5	12.1	
12/13/91	0901-1000	70.8	13.2	24 3
12/13/81	1001-1100	<b>37.3</b>	56.3	230
12/13/81	1100-1200	239.3	61.2	270
12/13/81	1200-1300	274.0	3.4	254
12/13/31	1300-1400	235.7	3.3	243
12/13/31	1400-1500	282.9	3.0	255
12/13/81	1500-1600	233.4	3.3	269
12/13/81	1500-1700	292.2	2.9	248
12/13/31	1700-1900	292.2	3.0	24 3
12/13/81	1800-1900	304.2	5.2	249
12/13/81	1900-2000	324.5	22.0	250

BLM- 3:	HOURLY AVERAGE	WIND I	DIRECTION	S & S	IGMAS
DATE	TIME PERIOD	ØIR>	SIGMA	N	LONAS
12/15/81	1901-2000	310.3	14.0	255	
12/15/31	2230-2330	309.2		251	
12/15/31	2331-0030	315.2	3.0	257	
12/16/81	0031-0130	17.8	21.8		
12/16/81	0131-0230	29.3	5.2	258	
12/16/81	0231-0326 0341-0441	41.0			
12/16/81	0341-0441	4.1	$\frac{14.0}{12.4}$	233 256	
12/15/81	0442-0541	17.6	10.3	253	
12/16/81	0541-0641 0641-0741	45.2		254	
12/15/81	0641-0741	32.2		252	
12/16/91		22.1		251	
12/16/81	0841-0941	18.4		253	
12/16/81	0942-1041	339.3		254	
12/16/31	1042-1144	299.0			
12/16/31 12/16/81	1145-1244 1230-1329	278.0	9.5		
12/16/31	1330-1329	296.2	5.3		
12/16/81	1431-1530	297.6 316.8	3.0	262	
12/16/81	1501-1600	322.2	5.7 4.1	258	
12/16/81	1630-1730	315.2	3.0	258	
	1731-1830	320.6		262	
	1831-1930	313.2	7.0	257 257	
12/16/81	1931-2030	328.4		257	
12/17/81	0300-0900	78.4	18.1	259	
12/17/81	0900-1000	87.9	8.5	260	
12/17/81	1000-1100	92.4	13.5	260	
12/17/81	1100-1200	117.9	6.1	259	
12/17/81	1200-1300	39.0		261	
12/17/81	1300-1400	51.2	17.8	260	
12/17/81	1401-1500	75.6		258	
12/17/81	1500-1600	179.4	82.7	260	
12/17/81	1600-1700	252.2	10.3	257	
12/17/81	1700-1800	238.9	99.8	259	
12/17/81	1800-1900	201.0	53.3	259	
12/17/81	1900-2000	41.6	37.7	259	
12/17/81	2000-2100	116.8	21.7	259	
12/17/81	2101-2200	135.4	3.1	259	
12/17/81	2201-2300	132.8	4.1	259	
12/17/81	2301-0000	139.7	4.5	259	
12/18/91	0001-0100	135.6	4.0	259	
12/13/31 12/18/31	0101-0200 0200-0300	144.J 138.9	<u>8.0</u>	259	
12/13/31	0301-0400	151.4	6.5 10.5	259	
12/13/31	0401-0500	183.7	12.7	257	
12/19/31	0501-0600	179.1	7.9	257 226	
12/18/81	0601-0700	169.3	23.2	257	
			~ ~ . ~	<b>-</b> - /	

BLM- 3:	HOURLY AVERAGE	WIND	DIRECTIONS	&	SIGMAS
DATE	TIME PERIOD	(DIR)		N	
12/13/81	2104-2200	118.7	11.2	226	•
12/13/81	2200-2300	107.3	18.5	249	)
12/13/81	2304-0000	56.1	30.4	232	<u>.</u>
12/14/81	0001-0058	54.9	21.4	240	)
12/14/31	0059-0156	22.1		240	<b>)</b>
12/14/81	0157-0254	16.0	11.7	241	
12/14/31	0255-0352	317.7		240	}
12/14/81	0353-0450	341.7		240	)
12/14/81	0451-0548	83.3		239	
12/14/81	0549-0646	350.2	30.6	239	)
12/14/81		31.9		212	
12/14/81 12/14/81	0801-0900	13.0	20.5	249	)
12/14/81	0901-1000	313.0	17.3	249	
12/14/81	1001-1100	300.7	20.4	247	•
12/14/81	1101-1200	292.7	2.9	249	
12/14/81	1201-1300	292.9		248	
12/14/31	1301-1400	292.6		247	
12/14/81	1401-1500	292.2		257	
12/14/91	1430-1530	292.7		268	
2/14/31	1546-1638	235.2		225	
12/14/81	1633-1730	300.0	4.7	224	
12/14/81	1730-1822	304.5	0.0	224	
12/14/31	1322-1929	300.9	14.0	29ປ	1
12/14/31	1935-2030	300.4		244	:
12/14/81	2000-2100	298.5		273	
12/14/81	2230-2330	298.6		253	
12/14/81	2330-0030	36.8		251	
12/15/81	0030-0130	114.9		259	)
12/15/81	0130-0230	105.4		259	)
12/15/31	0230-0330	90.9		259	•
12/15/91	0330-0430	<b>62.4</b>		259	•
12/15/31	0430-0530	278.3	12.5	259	•
12/15/81	0530-0630	311.5	26.6	259	)
12/15/81	0630-0730	61.0	36.0	257	
12/15/91	0700-0800	46.1	63.3	256	
12/15/81	0900-1007	157.0	32.3	253	
12/15/81	1008-1103	241.7		253	
12/15/31	1103-1208	293.3	7.7	255	٠
12/15/31	1209-1303	306.3		253	
12/15/91	1308-1403	343.5		254	
12/15/31	1349-1448	357.4		253	
12/15/31	1500-1600	296.7	1j.j	262	
12/15/31 12/15/31	1600-1700 1701-1300	299.4		259	
12/15/31	1301-1300	303.3 315.5	4.3 50.7	259 257	, 1

Table 9d. One-hour average wind directions, wind direction variances and the number of 10 sec. wind averages for BLM-4.

PLM-4:	HOURLY AVERAGE	MIND DIE		& SIGMAS
DATE	TIME PERIOD	<dir></dir>	SIGMA	N
06/21/82		277.7	6.1	24 0
06/21/82		284.3	11.9	261
06/21/82		310.3	7.8	262
06/21/82		298.7	3.8	263
06/21/82		308.0	17.4	262
06/21/82		336.2	22.3	262
06/21/82		285.3	19.5	262
06/21/82		262.9	18.2	251
06/21/82		261.1	28.1	261
06/21/82		274.0	5.1	262
06/21/82		271.2	8.6	259
06/21/82		273.9	6.7	216
06/21/82		280.5	3.8	260
06/21/82		278.1	3.0	263
06/21/82		272.9	4.2	261
06/21/82		273.9	6.0	261
06/21/82		273.3	5.9	260
06/21/82		281.5	2.3	263
06/21/82		288.7	3.5	260
06/21/82		297.2	3.6	260
06/21/82		289.2	3.1	260
06/22/82		302.0	5.4	259
06/22/82		302.9	8.2	259
06/22/82		344.0	11.9	259
06/22/82		331.4	11.3	259
06/22/82	2 0401-0500	323.6	9.5	261
06/22/82		313.4	9.9	259
06/22/82		294.1	5.7	259
06/22/82		342.2	28.9	266
06/22/82		295.0	63.6	261
06/22/82		213.9	8.2	263
06/22/82		201.5	6.4	224
06/22/82		222.8	10.5	260
06/22/82		232.1	7.5	217
06/22/82		254.2	10.8	258
06/22/82		262.7	3.6	259
06/22/82		267.4	3.3	260
06/22/82		273.3	5.6	259
06/22/82	2 1730-1830	279.3	8.5	261
06/22/82		277.0	12.1	258
06/22/82		277.6	12.4	260
06/22/82		280.4	20.9	259
06/22/82		301.9	15.9	261
06/22/82		291.3	30.2	261
05/22/32		277.7	52.5	260
76/23/82		307.6	11.2	261
06/23/82		333.2	23.3	251
06/23/82		7.9	31.9	260
06/23/82	2 0331-0430	38.7	13.1	260

DTM 4. 1	1001DIV 100D1CD	WIND DIR	PCMIONS	& SIGMAS
BLM-4: I	HOURLY AVERAGE TIME PERIOD	<dir></dir>	SIGMA	N
	0431-0530	337.0	33.1	260
06/23/82 06/23/82	0531-0630	331.1	18.9	256
06/23/82	0601-0700	334.6	26.4	253
06/23/82	0800-0900	180.1	28.9	265
06/23/82	0950-1050	343.1	11.3	264
06/23/82	1134-1234	290.4	6.6	263
06/23/82	1414-1524	241.5	9.0	267
06/23/82	2110-2210	328.6	20.0	265
06/23/82	2307-0007	16.5	18.2	266
06/24/82	0128-0228	288.9	4.7	262
06/24/82	0331-0431	296.8	8.3	263
06/24/82	0810-0858	327.5	25.7	211
06/24/82	0902-1000	253 <b>.</b> 9	19.4	244
06/24/82	1001-1100	294.0	22.8	259
06/24/82	1030-1130	305.8	19.8	260
06/24/82	1200-1300	39.8	14.7	265
06/24/82		266.5	12.1	261
06/24/82		274.0	6.2	261
06/24/82	1501-1600	271.7	2.7	261
06/24/82	1600-1700	266.9	3.3	262
06/24/82		263.0	3.4	260 260
06/24/82		277.0	7.3 2.5	260
06/24/82		283.8	4.4	254
06/24/82		289.6 297.1	7.0	173
06/24/82		305.9	9.5	261
06/24/82 06/24/82		330.4	15.1	261
06/25/82		350.2	34.1	260
06/25/82		40.2	66.5	262
05/25/82		289.7	23.5	260
06/25/82		313.0	7.7	259
06/25/82		323.2	9.5	260
06/25/82		311.9	13.8	258
06/25/82		310.6	8.8	258
06/25/82		316.7	10.3	260
06/25/82		2.4	18.3	256
06/25/82		307.3	22.0	262
06/25/82		289.4	6.7	261
06/25/82		282.7	2.3	260
06/25/82		276.3	1.7	261
06/25/82 06/25/82	1300-1400	278.5	2.6	260 253
		282.8	3.1	
06/25/82		285.1	1.3 2.8	263 261
06/25/82		286.1 294.3	2.9	261
06/25/82		294.3	2.2	261
06/25/82	_	293.5	9.0	265
06/25/82 06/25/82		305.7	5.2	260
36/27/82		290.2	3.7	263
06/27/32		284.0	2.0	263

	OURLY AVERAGE		ECTIONS	& SIGMAS
DATE	TIME PERIOD	<dir></dir>	SIGMA	N
06/27/82	1300-1400	284.5	2.3	222
06/27/82	1400-1500	283.6	2.9	263 263
06/27/82	1501-1600	284.8	2.4	263
06/27/82	1601-1700	284.9	2.4 3.1	267
06/27/82	1930-2030	291.8 293.1	3.4	263
06/27/82	2031-2130	302.4	4.3	257
06/27/82	2132-2230 2200-2300	306.6	4.5	264
06/27/82	2330-0030	299.2	7.5	269
06/27/82 06/23/82	0031-0130	307.5	13.2	262
06/28/82	0131-0230	309.1	6.8	262
06/28/32	0231-0330	320.9	29.1	263
06/28/82	0331-0430	294.4	75.3	263
06/28/82	0401-0500	305.9	56.7	262
06/23/82	0530-0630	298.9	19.7	269
06/28/82	0631-0730	272.0	15.8	265
06/28/82	0730-0830	290.5	17.2	265
06/28/82	0831-0930	304.5	21.4	264
06/28/82	0931-1030	283.6	6.8	262
06/28/82	1031-1130	275.2	12.9	263
06/28/82	1100-1200	282.0	8.8	249
06/28/82	1230-1330	267.9	7.8	267
06/28/82	1330-1430	272.9	5.6	265
06/28/82	1430-1530	272.0	2.8	265
06/28/82	1530-1630	276.4	2.3	264
06/28/82	1630-1730	278.5	3.2	264
06/28/82	1730-1830	280.9	4.7	264
06/28/82	1801-1900	286.6	3.5	262
06/29/82	0730-0830	171.7	10.6	267
06/29/82	0831-0930	171.5	8.1	260 264
06/29/82	0931-1030	193.6	5.8	264
06/29/82	1130-1230	180.2	11.2	267 263
06/29/82	1231-1330	219.0	13.2	202
06/29/82	1331-1430	225.4	8.4	263
06/29/82	1431-1530	234.6 271.7	6.9 13.1	262
06/29/82	1531-1630	297.3	25.8	263
06/29/82	1631-1730 1701-1800	8.5	56.1	263
06/29/82 06/30/82	0622-0722	302.5	3.4	263
06/30/82	0938-1038	321.4	3.0	265
06/30/82	1218-1318	246.2	27.1	269
06/30/82	1249-1348	270.3	6.4	264
06/30/82	1434-1543	260.8	4.4	270
06/30/82	1513-1613	268.6	5.2	267
06/30/82	1655-1755	278.4	3.8	266
06/30/82	1726-1825	283.8	3.4	253
06/30/82	1942-2042	310.2	3.4	270
06/30/82	2203-2303	306.4	3.9	190
07/01/82	0853-0953	292.3	7.0	266
07/01/82	0923-1023	297.8	2.3	265
07/01/82	1242-1342	309.1	3.4	263
07/01/32	1422-1522	309.2	3.7	263

## IV-6. Ship Movements and Relative Wind

Since the data reported here were gathered in the coastal region where there can be large spatial inhomogeneities, it is important to know the ship's location. During the tracer gas releases, the ship was anchored at the appropriate distance from shore. At other times, it would be drifting, steaming slow or full ahead, taking data further at sea for homogeneity studies, etc.

The quality of the data depends on the direction of the relative wind over the ship. When the wind is from the stern, heat from the ship's exhaust can cause false temperature readings if the wind speed is low. When the direction is more than about 45° off the bow the turbulence sensors are affected, while the upper level mean sensors give valid data. Normal procedure when taking data is to keep the ship into the wind. This is not always possible, such as when a 24 hour operation is in progress and the ship must follow a prescribed track.

In this section we give both ship location and movement and relative wind data. These data can be used to assess the quality of meteorological data and determine the locations where data were obtained. Note that we do not attempt here to give exact ship locations throughout the cruises (that would be too voluminous). Exact locations can be obtained from NPS if they are needed. Here we give appropriate locations so that the scenarios under which data were gathered are known. The relative wind directions appear in table 10.

## A. Ship Movements

	•	
BLM-1	(1980)	
9/21	0905	Underway from Monterey
	0955	Proceed south ≈5 miles offshore
	1700	4 nmi off Piedras Blancas light
	1900	Off Pt Buchon
9/22	0300	Round Pt Conception
	0325	Proceed east in Santa Barbara Channel
	1040	Drift near Ventura ≈ 5 nmi from shore
,	1300	Underway for Anacapa to do sea surface temperature work
	1400	Go through Anacapa passage
	1415	5 nmi off Santa Cruz Island, in lee
	1700	Move ship out of lee of island
	1813	Underway to release area
	1930	On station 8 nmi from shore off Ventura.
		Drift overnight
9/23		Drift all day in general Ventura area
9/24	0645	Underway for release position
	0730	On station ~ 4 nmi from coast near Ventura
	1045	Reposition ship to release position
	1055	Anchor ship for SF <sub>6</sub> release
		Remain at anchor overnight
9/25	1000	Underway for Port Hueneme
	1115	In Port Hueneme
9/27	0500	Underway from Port Hueneme
	0640	On station off Ventura, drifting
	1030	Move ship to SF <sub>6</sub> release position
	1103	Anchored on station
		Remain for the day

9/28	0915	Pull anchor, move to new position
	0930	At SF <sub>6</sub> release position
	0945	Anchor on station
	1915	Pull anchor and head for Port Hueneme
	2030	Dock at Port Hueneme
9/29	0500	Underway from Port Hueneme
	0615	Drift at approximate position of Ventura
	1135	Drop anchor at SF6 release position
	1930	Underway for Port Hueneme
	2030	Dock at Port Hueneme
9/30	1015	Underway from Port Hueneme
		Proceed to area south of Channel Islands to work
		oceanic cold fronts
10/1	1630	Depart for Monterey
BLM-2	(1981)	
1/5	0950	Underway from Monterey
	1010	Proceed south ~5 miles off shore
	1800	Off Piedras Blancas Pt.
1/6	0525	Off Pt. Conception
	1320	Anchor at SF6 release position off Ventura
		Remain at anchor overnight
1/7	1125	Move ship to proposed release position
	1142	Drift at position
	1530	Move to proposed release position for tomorrow
	1550	Anchor, remain overnight
1/8		Remain at anchor off Ventura

1/9	1110	Move to new SF <sub>6</sub> release position
	1125	Anchor at new position
	1825	Pull anchor and underway for Port Hueneme
	1955	Dock at Port Hueneme
1/13	0500	Underway from Port Hueneme
	0615	Drift at approximate SF6 release position
	1000	Move ship back to release position
	1020	Drift at position
	1110	Move ship back to position
	1135	Drop anchor at SF <sub>6</sub> release position
		Remain at anchor through night
1/14	1215	Pull anchor and move to proposed release position
	1445	Anchor for the night near Ventura
1/15	1240	Pull anchor and move ship to proposed SF <sub>6</sub> release
		position
	1355	Anchor at release position
	1355 1715	
		Anchor at release position
	1715	Anchor at release position  Pull anchor and underway to Port Hueneme
1/16	1715	Anchor at release position  Pull anchor and underway to Port Hueneme  Put personnel ashore at Port Hueneme
1/16	1715 1820 0900	Anchor at release position  Pull anchor and underway to Port Hueneme  Put personnel ashore at Port Hueneme  Leave for San Diego area at ~10 miles off shore
1/16	1715 1820 0900	Anchor at release position  Pull anchor and underway to Port Hueneme  Put personnel ashore at Port Hueneme  Leave for San Diego area at ~10 miles off shore  Turn into wind, ~ 20 miles off San Diego, take data
·	1715 1820 0900	Anchor at release position  Pull anchor and underway to Port Hueneme  Put personnel ashore at Port Hueneme  Leave for San Diego area at ~10 miles off shore  Turn into wind, ~ 20 miles off San Diego, take data
·	1715 1820 0900 2300	Anchor at release position  Pull anchor and underway to Port Hueneme  Put personnel ashore at Port Hueneme  Leave for San Diego area at ~10 miles off shore  Turn into wind, ~ 20 miles off San Diego, take data
BLM-3	1715 1820 0900 2300 (1981)	Anchor at release position  Pull anchor and underway to Port Hueneme  Put personnel ashore at Port Hueneme  Leave for San Diego area at ~10 miles off shore  Turn into wind, ~ 20 miles off San Diego, take data  Stop taking data, head for San Diego
BLM-3	1715 1820 0900 2300 (1981) 0830 0900	Anchor at release position  Pull anchor and underway to Port Hueneme  Put personnel ashore at Port Hueneme  Leave for San Diego area at ~10 miles off shore  Turn into wind, ~ 20 miles off San Diego, take data  Stop taking data, head for San Diego  Underway from Monterey
BLM-3	1715 1820 0900 2300 (1981) 0830 0900 1748	Anchor at release position  Pull anchor and underway to Port Hueneme  Put personnel ashore at Port Hueneme  Leave for San Diego area at ~10 miles off shore  Turn into wind, ~ 20 miles off San Diego, take data  Stop taking data, head for San Diego  Underway from Monterey  Turn to south, sail at ~ 5 miles from shore
BLM-3	1715 1820 0900 2300 (1981) 0830 0900 1748	Anchor at release position  Pull anchor and underway to Port Hueneme  Put personnel ashore at Port Hueneme  Leave for San Diego area at ~10 miles off shore  Turn into wind, ~ 20 miles off San Diego, take data  Stop taking data, head for San Diego  Underway from Monterey  Turn to south, sail at ~ 5 miles from shore  Off Pt. Buchon

12/7		Drift for the day and repair equipment
	1715	Reposition ship
	1823	Back at position for drifting
12/8	0652	Head for Avila to pick up personnel and equipment.
	0755	Leave Avila Beach
	0919	Drifting at release position
	1153	Anchor at SF <sub>6</sub> release position
		Remain at anchor overnight
12/9		Remain at anchor throughout the day
12/10	0915	Pull anchor and move ship to proposed position
	0940	Drifting, waiting for wind
	1300	Move ship back to release position
	1700	Reposition ship, anchor and remain overnight
12/11	1155	Pull anchor and move to SF <sub>6</sub> release position
	1224	Anchor at position
		Remain at anchor overnight
12/12	0925	Pull anchor and head for Avila Beach
	1040	Anchor at Avila Beach, shore leave
	2240	Pull anchor and go back to SF <sub>6</sub> release position
		off Pismo Beach
	2330	Drift at release position
12/13	1120	Move ship into position
	1146	Anchor at release position
		Remain at anchor overnight.
12/14	1015	Move ship to proposed SF <sub>6</sub> release position
	1030	Anchor ship at release position
		Remain at anchor overnight

12/15 0730 Pull anchor, go in to pick up radiosondes 0843 Leave Avila, go back to station 0939 On station, drift. 1055 Move ship to new proposed SF<sub>5</sub> release position 1115 Drop anchor at new position 2000 Pull anchor and go to Avila Beach 2100 Put personnel ashore, sail to Pt Buchon Drift at ~ 5 nmi off Pt Buchon 2215 12/16 0250 Move ship to 10 nmi offshore At 10 nmi, check wind, proceed to 15 nmi offshore 0325 0338 Stop ship and drift at ~12 nmi to look for land-sea breeze extent. 0720 Underway back to SF6 release area, 3 nmi offshore 0810 Stop at release area, drift 1105 2/3 ahead to W Change course to N toward Pt Buchon 1615 1900 Stop at ~ 3 nmi off Pt Buchon and drift overnight, waiting for fog 12/17 0738 Move 1/2-ahead to north Full ahead to west. 0855 1130 Still sailing west, at 50 nmi offshore 1345 At 70 nmi offshore 1400 Turn ship and head north 1920 Stop ship off Pt Sur, drift and wait for fog Slow ahead into wind (145°) 12/18 0033 0310 Full speed ahead for Monterey Bay Slow ahead into wind at ~ 5 nmi off Monterey (160°) 0610 J702 End experiment, head for Monterey

BLM-4	(1982)	
6/20	1038	Underway from Monterey
	1242	Head south at ≈ 5 nmi off shore
	2100	Off Moro Bay
6/21	0000	1/2-ahead from Pt Buchon toward release area
	0207	Stop ship and drift at SF6 release area, 3 nmi
		off Pismo Beach
	0830	Move ship to place marker buoys
	1050	Back at release area, drift
	1206	Move ship to SF <sub>6</sub> release position
	1218	Anchor at release position
		Remain at anchor overnight
6/22	1055	Pull anchor and move ship to new SF <sub>6</sub> release
		position
	1115	Drifting at the new position
	1312	Underway to redesignated SF6 release position
	1338	Drop anchor at release position
	2340	Pull anchor and head toward Pt Buchon
6/23	0140	2 nmi off Pt Buchon, turn towards Moro Bay
	0223	3 nmi off Moro Bay, turn to due N
	0303	At northernmost point of Moro Bay, 1 nmi off shore,
		turn to due S
	0528	Due W of SF6 release area at 15 nmi off shore,
		turn to due E to return to release area
	0707	Back at release area, 5 nmi out, drift
	0725	Slow ahead into the wind
	0906	Move ship to ly nmi from shore

0945 Slow ahead into the wind at 10 nmi 1056 Move ship to 15 nmi from shore Slow ahead into the wind at 15 nmi 1130 1237 Return to 5 nmi from shore Slow ahead into the wind at 5 nmi 1400 Drift at ~ 7 nmi from shore 1527 Slow ahead into the wind at 5 nmi 2003 2035 Move to 10 nmi from shore Slow ahead into the wind at 10 nmi 2109 2212 Move to 15 nmi from shore Slow ahead into the wind at 15 nmi 2305 Move to 10 nmi from shore 6/24 8000 0122 Slow ahead into the wind at 10 nmi 0230 Move to 5 nmi from shore 0335 Slow ahead into the wind at 5 nmi 0433 Move to 10 nmi from shore 0456 Slow ahead into the wind at 10 nmi 0530 Move to 5 nmi from shore 0615 Slow ahead into the wind at 5 nmi 0649 Move to 2 nmi from shore 0715 Slow ahead into the wind at 2 nmi 0754 Move ship to proposed SF6 release position at 3 nmi from shore 8080 Drift at release position 0900 Make small corrections of ship position while

Anchor at release position, remain at anchor overnight

waiting for release

1147

6/25		Remain anchored at this position for the next SF <sub>6</sub>
		release
	1900	Pull anchor and move to tend buoys
	1920	Move to Moro Bay area and work there overnight
6/26	0500	Depart Moro Bay for Avila Beach
	0810	Anchor at Avila Beach
6/27	0630	Depart Avila Beach, proceed to repair buoys
	0800	Repair buoy
	0905	Move to projected SF <sub>6</sub> release position
	1026	Anchor at release position, remain at anchor overnight
6/28	1025	Pull anchor and move to SF <sub>6</sub> release position at 5
		nmi from shore
	1045	Drift at release position
	1150	Move to corrected release position
	1210	Anchor at release position
	1938	Move ship to work Moro Bay area overnight
6/29	0500	Head back to release area
	0720	Back at 5 nmi SF6 release position, drift
	1110	Move back to release position
	1206	Rotate the ship into the wind
	1339	Move to new SF <sub>6</sub> release position
	1349	Anchor at release position
	1335	Pull anchor and proceed to remove buoys
	2000	Move to 20 nmi from shore and drift.
6/30	0724	Move to 10 nmi from shore
	0845	Slow ahead into the wind at 10 nmi
	1042	Move to 1/2 nmi from shore
	1217	Slow ahead into the wind at 1/2 nmi

- 1352 Move back to 1/2 nmi from shore
- 1430 Slow ahead into the wind at 1/2 mile
- 1619 Return to 1/2 nmi from shore
- 1650 Slow ahead into the wind at 1/2 nmi
- 1830 Move to 10 nmi from shore
- 1938 Slow ahead into the wind at 10 nmi
- 2045 Move ship to 18 nmi from shore
- 2200 Slow ahead into the wind at 18 nmi
- 2300 Move ship to 3 nmi from shore and drift overnight.
- 7/1 0518 Slow ahead into the wind at 3 nmi
  - 0551 Move to 1/2 nmi from shore
  - 0631 Stop at 1/2 nmi
  - 0758 Hold ship into the wind at 3 nmi
  - 0840 Move to 5 nmi from shore
  - 0850 Slow ahead into the wind at 5 nmi
  - 1027 Move to 10 nmi from shore
  - 1055 Slow ahead into the wind at 10 nmi
  - 1140 Move to 20 nmi from shore
  - 1243 Slow ahead into the wind at 20 nmi
  - 1454 End of operation, leave for Monterey

Table 10a. One-half hour average relative wind directions for BLM-1.

date time	.D(rel)	date time 09/27 1810	:.D(rel)
00/03/15/0	3 = 7	09/27 1838	340
09/23 1642	357	09/27 1906	343
09/23 1717	353 354	09/27 1307	25
00/23 1749	334 55	39/28 1335	15
09/24 1137		09/28 1408	14
09/24 1205	209	09/28 1435	21
09/24 1233	3 á	09/28 1504	11
09/24 1301	18 25	09/28 1504	7
09/24 1329	23 17	09/28 1600	352
03/24 1357	4	09/28 1628	347
03/24 1425		09/23 1740	342
09/24 1453	35d	09/23 1740	335
09/24 1521	345 339	09/28 1836	332
09/24 1549	342	09/23 1904	325
09/24 1617	342	09/29 1217	32
09/24 1645	348	09/29 1245	35
09/24 1713 09/24 1741	336	09/29 1319	45
09/24 1741	345	09/29 1347	33
09/24 1905	353	09/29 1415	32
09/24 1303	61	09/29 1443	23
09/27 0743	64	09/29 1511	21
09/27 0743	232	09/29 1540	ó
09/27 0945	276	09/29 1626	343
09/27 1013	283	09/29 1654	333
09/27 1041	281	09/29 1722	327
09/27 1138	23	09/29 1750	326
09/27 1206	21	09/29 1313	331
03/27 1234	17	09/29 1346	327
03/27 1302	īi	09/29 1002	322
09/27 1330	3		
39/27 1358	ì		
19/27 1425	353		
09/27 1454	353		
39/27 1522	351		
09/27 1550	351		
09/27 1518	351		
09/27 1546	347		
09/27 1714	342		
09/27 1742	342		

Table 10b. One-half hour average relative wind directions for BLM-2

date ti	me wD(rel		ime <u>WD(rel)</u> 439 345
01/06 13	55 5		509 349
	25 3		521 35ó
	55 12		559 345
	42 342		523 338
01/06 l5			659 336
	350 350 350	01/13 1	729 349
	712 344		130 343
	742 341	01/14 1	<del></del>
01/06 17 01/06 18		01/14 1	
01/06 16			300 316
	12 356		330 259
· -, · · ·	942 77		400 282
01/06 19		01/14 1	
01/07 12	232 67		500 347
	320 83		441 11
01/07 13	350 31	01/15 1	
	420 5 ó	01/15 1	552 55
	450 200	01/15 1	
	149 27ó	01/15 1	
	221 . 352	01/15 1	
	309 340	01/16 0	i938 34ó
	339 348	01/10 1	.008 335
	409 352	01/16 1	
u1/J9 1	439 . 353	01/16 1	
	509 351	01/16 1	.150 13
	539 343	31/15 1	13
	509 346	01/15 i	L250 9
	539 347	01/16 1	L320 350
	709 333	01/1ő 1	L350 l
	739 338	01/15 1	
,	345	U1/16 J	L450 333
	d52 79	J1/1o 1	
	943 74		1550 345
	049 243	•	1620 346
	119 235		1550 343
	.239 345		
	309 348		
	340 ورق		1320 356
	.4U9 35U	J1/16 :	1350 352

BLM-2 1981

date time	wD(rel)	date time	WD(rel)
J1/16 1920	o		
01/13 1950	340		
01/10 2020	355		
01/16 2050	263		
01/16 2120	351		
01/16 2150	14		
01/10 2220	ક		
01/16 2250	13		

Table 10c. One-half hour average relative wind directions for BLM-3.

date time	WD(rel)	date time 12/09 0452	<u> </u>
12/08 1109	70	12/09 0452	332
12/08 1109	70 70	12/09 0552	342
12/06 1119	68	12/09 3622	342
12/03 1139	22	12/09 0652	17
12/03 1139	24	12/09 0722	345
12/08 1159	63	12/09 0752	331
12/08 1209	72	12/09 0822	354
12/08 1219	40	12/09 0352	7
12/08 1252	343	12/09 0922	à
12/08 1352	13	12/09 0952	311
12/03 1422	10	12/09 1022	347
12/08 1452	17	12/09 1052	7
12/08 1522	10	12/09 1122	352
12/08 1352	344	12/09 1152	355
12/08 1622	24	12/09 1222	359
12/08 1652	344	12/09 1252	3 3 ő
12/08 1722	10	12/09 1322	333
12/08 1752	303	12/09 1352	327
12/08 1322	234	12/09 1422	319
12/08 1852	279	12/09 1452	297
12/03 1922	315	12/09 1522	236
12/08 1952	3 38	12/09 1552	225
12/08 2022	350	12/09 1622	260
12/08 2052	3 34	12/09 1552	261
12/08 2122	295	12/09 1722	231
12/03 2152	354	12/09 1752	327
12/08 2222	44	12/09 1822	336
12/08 2252	<b>60</b>	12/09 1352	319
12/08 2322	22	12/09 1922	316
12/08 2352	20	12/09 1952	290
12/09 0022	50	12/09 2022	322
12/09 0052	48	12/09 2052	25
12/09 0122	311	12/09 2122	35
12/09 0152	163	12/09 2152	277
12/39 3222	266	12/09 2222	173
12/09 0252	3 39	12/09 2252	227
12/09 0322	283	12/09 2322	233
12/09 0352	292	12/09 2352	166
12/09 0422	290	12/10 0022	133

BLM-3 1981

date tim	wD(rel)	date time	wD(rel)
12/10 005	2 224	12/11 0100	40
12/10 012	2 247	12/11 0130	31
12/10 015		12/11 0200	29
12/10 022		12/11 0230	i
12/10 025		12/11 0300	7
12/10 032		12/11 0330	353
12/10 035		12/11 0400	333
12/10 042		12/11 0430	77
12/10 045		12/11 0500	72
12/10 054		12/11 0530	40
12/10 05		12/11 0600	19
12/10 062		12/11 0630	23 18
12/10 06		12/11 0700	27
12/10 07		12/11 0730	ól
12/10 07		12/11 0300	333
12/10 08		12/11 0330	112
12/10 08:		12/11 0900 12/11 0930	221
12/10 10	22 249	12/11 1003	130
12/10 10:	52 235	12/11 1030	215
12/10 11		12/11 1030	261
12/10 11	52 106	12/11 1130	342
12/10 12		12/11 1203	35 <b>7</b>
12/10 12	52 178	12/11 1300	348
12/10 13		12/11 1330	356
12/10 14	22 169 52 107	12/11 1330	359
12/10 14		12/11 1430	358
12/10 15		12/11 1500	ง
12/10 15		12/11 1530	357
12/10 16 12/10 18	-	12/11 1600	355
12/10 ld 12/10 l9		12/11 1630	356
12/10 19		12/11 1657	1
12/10 20		12/11 1724	357
12/10 20		12/11 1751	2
12/10 21		12/11 1818	1
12/10 22		12/11 1345	3
12/10 23	-	12/11 1912	10
12/10 23	* -	12/11 1333	334
12/11 00		12/11 2006	133
	30 0	12/13 1030	290
,			

BLM-3 1981

<u>da te</u>	time	WD(rel)	date time	WD(rel)
12/13	1100	211	12/14 0800	33
12/13	1230	3 3 ó	12/14 0330	79
12/13	1300	345	12/14 0900	56
12/13	1330	346	12/14 0930	29
12/13		341	12/14 1000	5
12/13	1430	3 35	12/14 1100	349
12/13		3 37	12/14 1130	353
12/13		342	12/14 1200	352
12/13		341	12/14 1230	351
12/13		338	12/14 1300	349
	1700	3 39	12/14 1330	349
12/13		3 3 9	12/14 1403	343 344
12/13		3 3 9	12/14 1430	
12/13		350	12/14 1500	344 344
	1900	349	12/14 1530	349
12/13		351	12/14 1559	340
	2000	21	12/14 1512	345
12/13		275	12/14 1625	341
	2103	160	12/14 1638	344
	2130	148	12/14 1651 12/14 1704	341
	2200	155		350
	2230	160	12/14 1717 12/14 1730	345
12/13	2300	149	12/14 1730	351
	2330	215	12/14 1745	347
	0000	205	12/14 1/30	34 ó
	0029	217	12/14 1809	353
	0058	20 5 13 3	12/14 1322	352
	0127	90	12/14 1333	349
	0156 0225	353	12/14 1901	337
12/14	0254	13	12/14 1929	347
	0323	30	12/14 1958	349
12/14		23	12/14 2030	345
12/14		23	12/14 2100	344
	0421	57	12/14 2300	34€
	0450	162	12/14 2330	348
12/14		167	12/15 0000	17
	0617	137	12/15 0030	90
	0545	3 38	12/15 3103	33
	0723	98	12/15 0130	13
16/17	. 0/23	, ,		

BLM-3 1981

date	time	WD(rel)	date time	WD(rel)
12/15		327	12/16 0130	12 351
12/15		318	12/16 0200 12/16 0230	351 4
12/15	0300	315	12/16 0230 12/16 0251	14
12/15		296 279	12/16 0231	32
$\frac{12}{15}$		208	12/16 0325	18
12/13		3	12/16 0401	359
12/15	0530	27	12/16 0421	334
12/15		ó	12/16 0441	337
12/15		29	12/16 U5J1	337
12/15	טטדט	100	12/13 0521	330
12/15		215	12/16 0541	332 11
12/15		334	12/16 0601	24
12/15		20	12/16 0621 12/16 0541	332
12/15		41 349	12/16 0341	310
12/15	1148	15	12/16 0721	309
	1203 1228	23	12/13 0741	327
12/15	1228 1243	4	12/16 0301	327
12/13	1308	355	12/16 0841	289
	1328	5	12/16 0901	297
12/15	1348	49	12/16 0921	294
12/15	1408	36	12/16 U941	293
	1428	46	12/16 1001	293
12/15	1448	37	12/16 1021	291
12/15		341	12/16 1041	231 230
	1000	352	12/16 1101	15
	1630	351	12/16 1129 12/16 1144	13
	1700	347 35J	12/16 1159	3
12/15	1730	355	12/16 1214	359
	5 1800 5 1830	331	12/16 1229	1
	5 1900	323	12/15 1244	13
	5 1930	344	12/15 1259	14
12/15	2000	359	12/15 1314	25
12/1	2300	274	12/15 1329	23
12/1	5 2330	273	12/16 1400	17
12/18	5 0000	279	12/15 1430	19
12/1	<b>5</b>	291	12/16 1500	23 33
12/1	0100	3 37	12/13 1533	3 3

BLM-3 1981

date time	WD(rel)	date time	WD(rel)
12/16 1600	35	12/18 0000	80
12/15 1700	274	12/18 0050	31
12/16 1/30	270	12/18 0100	358
12/16 1300	273	12/18 0130	6
12/16 1330	2 <b>7</b> 5	12/18 0200	ő
12/15 1900	235	12/18 0230 12/18 0300	ð <del>1</del>
12/16 1930	273	12/18 0300	227
12/16 2000 12/16 2030	275 282	12/18 0330	173
12/16 2030 12/17 0830	202 33	12/16 0400	177
12/17 0030	173	12/13 3430	242
12/17 0930	13	12/13 0530	172
12/17 1000	23	12/18 0600	120
12/17 1030	33	12/13 0030	343
12/17 1100	355	12/13 0700	323
12/17 1130	3 3 9	- •	
12/17 1200	344		
12/17 1230	5		
12/17 1300	17		
12/17 1330	25		
12/17 1400	44		
12/17 1430	25		
12/17 1500	28		
12/17 1530	20		
12/17 1600	342		
12/17 1530	328		
12/17 1700	331		
12/17 1730	350		
12/17 1800	14		
12/17 1830	7		
12/17 1900	352 50		
12/17 1930	60 247		
12/17 2000 12/17 2030	247 5		
12/17 2030	ა ან		
12/17 21:0	75		
12/17 2200	76		
12/17 2230	7 š		
12/17 2300	73		
12/17 2330	79		

Table 10d. One-half hour average relative wind directions for BLM-4.

BLM-4 1982

	·-> / 1 \	date time	WD(rel)
date time	WD(rel)	$\frac{0.0000}{0.0000}$	325
06/21 0003	314	06/21 2230	329
_ •	235	06/21 2300	316
06/21 0030 06/21 0100	247	06/21 2330	296
06/21 0100	95	06/22 0000	289
	96	06/22 0030	299
		06/22 0100	311
06/21 0230 06/21 030J	90	06/22 0130	301
06/21 0300	89	06/22 0200	306
$J_0/21 0330$	87	06/22 0230	321
06/21 U430	93	06/22 0300	331
06/21 0430	11	06/22 0330	313
06/21 0530	303	06/22 0400	298
J6/21 J6UJ	308	06/22 0430	297
06/21 0630	88	06/22 0500	310
06/21 0700	93	u6/22 0530	304
06/21 0730	85	06/22 0600	314
06/21 0300	74	06/22 0630	315
05/21 0830	81	05/22 0700	3 3 3
U6/21 U935	337	06/22 0800	7
05/21 1030	31	06/22 0830	38
06/21 1100	13	06/22 0900	13
06/21 1130	327	0 <i>6</i> /22 0930	3 35
05/21 1200	266	J6/22 1J00	6
06/21 1230	328	U6/22 103U	355
06/21 1300	25	05/22 1100	336
U6/21 1330	12	ეგ/22 1130	40
06/21 1400	2	Já/22 12ÚÚ	71
05/21 1430	358	06/22 1230	75
06/21 1500	354	06/22 1300	71
00/21 1530	343	00/22 1400	7
06/21 1600	333	05/22 1430	<u>.</u>
05/21 1530	3 3 2	J6/22 150J	358
J6/21 1700	327	05/22 1530	349
06/21 1730	320	06/22 1500	343
00/21 1300	316	J6/22 163U	3 3 7
06/21 1330	321	05/22 1700	330
06/21 2030	316	05/22 1730	329
36/21 2100	321	06/22 1300	318
Jo/21 213J	32 á	uo/22 1330	321

BLM-4 1962

date time	wD(rel)	date time	MD(rel)
06/22 1300	304	06/24 0401	354
06/22 1930	317	06/24 0431	2
05/22 2000	303	06/24 0526	5
u6/22 2030	296	06/24 0648	357
06/22 2100	287	05/24 0748	275
06/22 2130	291	06/24 0630	64
06/22 2200	297	05/24 0858	15
06/22 2230	288	06/24 0927	ø 3
06/22 2300	298	06/24 1000	73
05/22 2330	265	06/24 1030	102
06/23 0000	324	06/24 1130	99
05/23 0030	35d	05/24 1230	338
06/23 0100	351	06/24 1300	339 315
05/23 0130	357	06/24 1330	315 319
06/23 0200	5	06/24 1400	324
06/23 0230	35d	06/24 1430	
06/23 0300	354	06/24 1500	323 321
06/23 0330	336	06/24 1530	321 316
06/23 0400	339	06/24 1600	317
06/23 0430	343	06/24 1630	
00/23 0500	353	06/24 1700	319 316
06/23 0530	39	06/24 1730	
06/23 0600	306	06/24 1300	322 328
06/23 0630	316	05/24 1830	
06/23 0700	342	06/24 1900	342 339
06/23 0830	315	06/24 1930	340
06/23 0900	17	06/24 2000	340
06/23 1020	356	06/24 2030	344
06/23 10:00	357	06/24 2100	344 347
05/23 1204	357	06/24 2130	344
06/23 1234	1	06/24 2200	331
05/23 1444	15	06/24 2230	3 3 6
00/23 1524	349	06/24 2300	351
06/23 2034	358	06/24 2330	343
06/23 2140	4.2	06/25 0000 06/25 0030	343 329
Jo/23 2210	14	06/25 0100	13
05/23 2337	l ó		53
Jo/24 0007	13	06/25 0130	
06/24 0153	344	06/25 0200	64 :53
06/24 0228	357	J6/25 J23U	450

BLM-4 1982

cate time	wD(rel)	date time	<pre>hD(rel)</pre>
06/25 0300	259	06/27 1330	345
06/25 0330	307	06/27 1400 06/27 1430	346 342
06/25 0400	309 314	06/27 1500	340
06/25 0430 06/25 0500	291	06/27 1530	340
06/25 0530 05/25 0530	272	06/27 1600	339
06/25 0600	285	06/27 1630	340
06/25 0630	318	06/27 1700	3 3 7
06/25 0700	337	06/27 1730	330
06/25 0730	351	06/27 1916	331
06/25 0800	Ü	06/27 2000	331
06/25 0830	17	<b>06/27 2030</b>	331
06/25 0900	43	05/27 2100	329
06/25 0930	22	06/27 2130	333
06/25 1000	353	U6/27 2200	337
06/25 1030	357	36/27 2230	340
U6/25 1100	329	06/27 2300	343
06/25 1130	326	06/27 2326	3 38
06/25 1200	321	06/28 0000 06/28 0000	342 354
06/25 1230	315	06/28 0030	354 3
06/25 1300	315	06/28 0100 06/28 0130	356
06/25 1330	317 319	06/28 0200	11
06/25 1400 06/25 1430	320	06/28 0230	3
06/25 1430	324	U6/28 0300	5 <b>7</b>
06/25 1500	322	06/28 0330	52
06/25 1600	322	06/28 0400	303
06/25 1630	320	06/28 0430	354
06/25 1700	324	<b>J6/23 J5J</b> 0	257
06/25 1730	327	06/23 0526	94
06/25 1800	325	06/28 0600	175
06/25 1830	325	06/28 0630	50
06/25 1913	274	06/23 0700	11
06/25 1955	343	06/23 0730	23
ũ6/25 2025	35ó	J6/28 J8JU	25
06/25 2055	353	06/28 0830	33
J6/27 1130	350	06/23 0900	17
06/27 1200	348	06/28 0930	3 3
06/27 1230	346	06/28 1000	2 2 2 6
06/27 1300	345	06/23 1330	339

BLM-4 1982

date time	wD(rel)	date time	WD(rel)
06/28 1130 06/28 1330 06/28 1330 06/28 1330 06/28 1430 06/28 1500 06/28 1530 06/28 1630 06/28 1630 06/28 1730 06/28 1730 06/28 1730 06/28 1800 06/28 1830 06/28 1900 06/29 0830 06/29 0830 06/29 0830 06/29 0930 06/29 1030 06/29 1230 06/29 1230 06/29 1230 06/29 1230 06/29 1330 06/29 1330	331 268 323 315 320 324 320 322 325 326 327 323 321 326 327 33 42 34 52 32 53 246 325 327 329 260 287 300 293 300 309 327 339 327 339 329 329 329 329 329 329 329 329 329	date time  06/30 1318 06/30 1504 06/30 1504 06/30 1543 06/30 1613 06/30 1725 06/30 1625 06/30 2012 06/30 2042 06/30 2233 06/30 2303 07/01 0545 07/01 0833 07/01 0923 07/01 0923 07/01 1131 07/01 1312 07/01 1342 07/01 1452 07/01 1522	#D(rel)  4 356 356 2 5 350 1 350 10 2 351 12 9 3 7 8 5 8 340
06/30 1008 06/30 1038 06/30 1243	7 3 359		

#### APPENDIX A CALIBRATION PROCEEDURES

The results of laboratory calibrations of meteorological sensors that are used for field measurements can be misleading. For example, platinum resistance temperature sensors can be calibrated to  $\pm 0.001^{\circ}$ C, or with the leads used in the field calibrated to  $\pm 0.01^{\circ}$ C. Such a calibration is repeatable and represents the basic capabilities of the sensors and of the calibration facility. When these sensors are used in the field, with the required aspiration, recognizing that at times the aspirator will be shaded and at times in direct sunlight, measurement accuracy of  $\pm 0.1^{\circ}$ C is doing well.

Measuring wind speed produces another problem because of ship influence. No matter how accurately the cups are calibrated, using them on, or near, the RV/Acania reduces the accuracy to ± 0.5 m/sec. The results on larger ships are worse. The attainable accuracies in the field are sufficient for this work, especially when one considers the use of the results. Meteorological parameters measured at a point are being used to predict plume behavior over a spatially large region, near the coast, where spatial inhomogeneities are great. Great measurement accuracy is not required but, of course, the sensors should be moderately well calibrated so that systematic errors are not introduced. The following are the calibration procedures used to insure the validity of the meteorological data obtained aboard the R/V ACANIA.

## Air, Sea, and Dewpoint Temperatures:

All temperature sensors are calibrated together in an insulated chamber. The air and sea temperature probes and a HP2801A quartz thermometer standard are mounted in an aluminum cylinder which effectively eliminates the temperature differences between these sensors. The differences are less than 0.01°C. The dewpoint thermometers cannot be mounted in the same block because they are permanently mounted to the mirror in the sensor. In the calibration chamber, the temperature difference between these sensors and the cylinder can be as much as 0.1°C.

The temperature measured by a sensor is found from its resistance by inverting the standard equation

$$R = R_0(1 + \alpha T),$$

where T is in °C,  $R_O$  the resistance at the ice point, and  $\alpha$  is the temperature coefficient. For the air temperature sensors  $\alpha=0.003921$ ; for the dewpoint sensors  $\alpha=0.003895$ . The calibration procedure is to determine the values of  $R_O$  for each sensor from the known calibration chamber temperature and the measured resistances. This is done at several temperatures to eliminate errors which can be introduced by temperature inhomogeneities in the chamber. Calibration accuracy is  $\pm 0.01^{\circ}$ C for the air and sea surface temperature sensors and  $\pm 0.1^{\circ}$ C for the dew point sensors.

### Wind Speed:

Calibrations are performed in one of the NPS wind tunnels using a calibrated hot wire sensor as the standard. We do not attempt to perform the calibration to an accuracy any greater than

± 0.5 m/sec. We have not found any errors or differences between sensors to be greater than ±0.5 m/sec. When the cups are used in the field, salt loading of the bearings can cause it to be outside of this range, but this is easily detected long before the calibration is affected by observing the decay rate of the shaft rotation when no cup is in place. Affected sensors are never used.

The acoustic sounder records are calibrated with radiosondes

### Inversion Height:

every 12 hours during most shipboard operations.

It is misleading, however, to consider this to be a good calibration of the sounder, it is only semi-quantitative. The acoustic return which the sounder senses comes from reflection from small scale temperature inhomogeneities. The inhomogeneities are caused by a combination of the temperature gradient and mechanical turbulence at the inversion. The return, thus, is not necessarily from the height where the temperature break occurs, which is the inversion height deterined from the radiosonde.

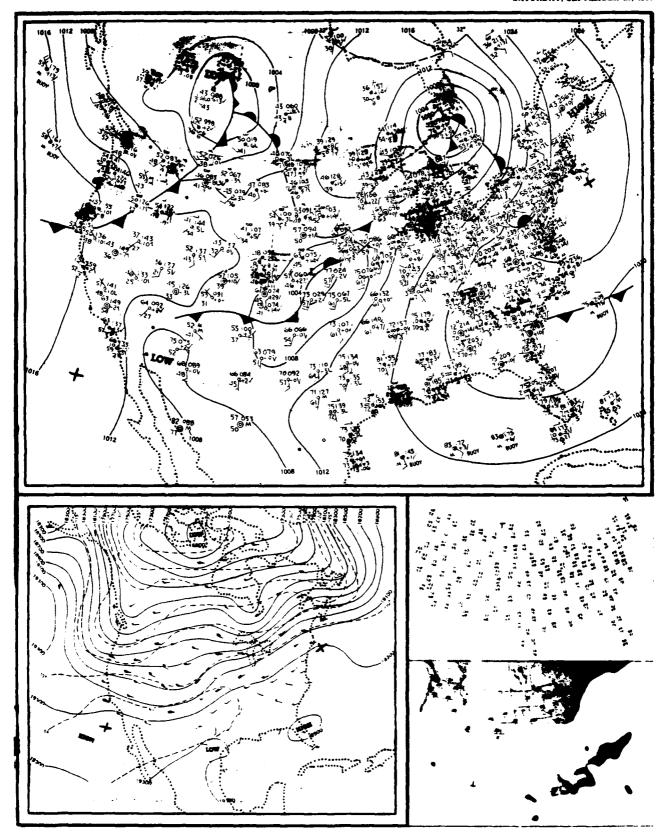
Normally, radiosonde and sounder determinations of boundary layer

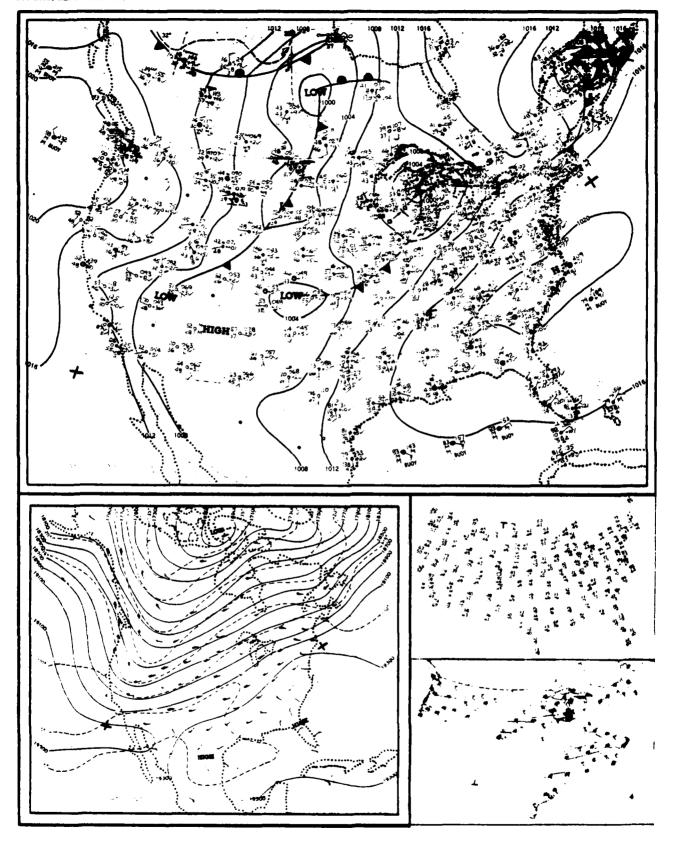
### Wind Speed Turbulence:

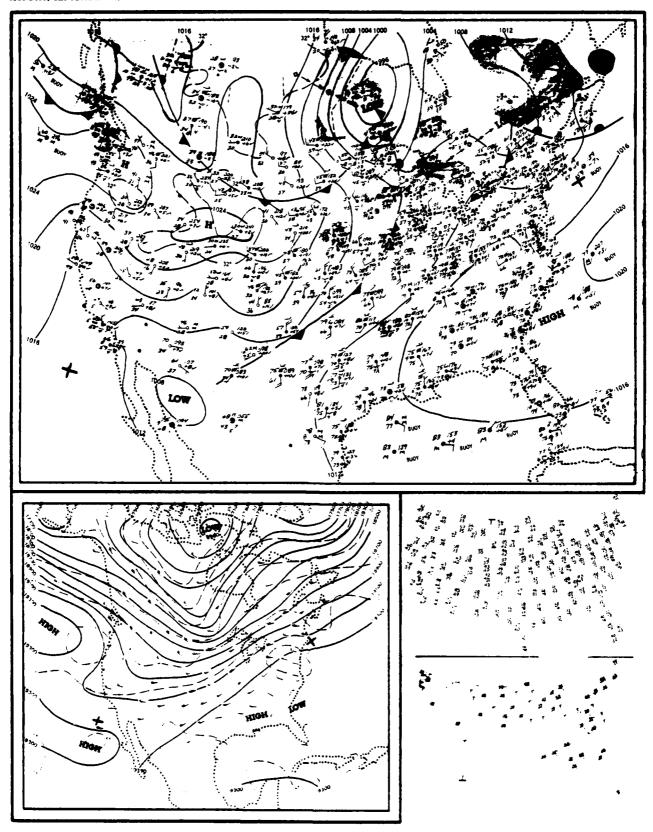
depth agree to within 40m.

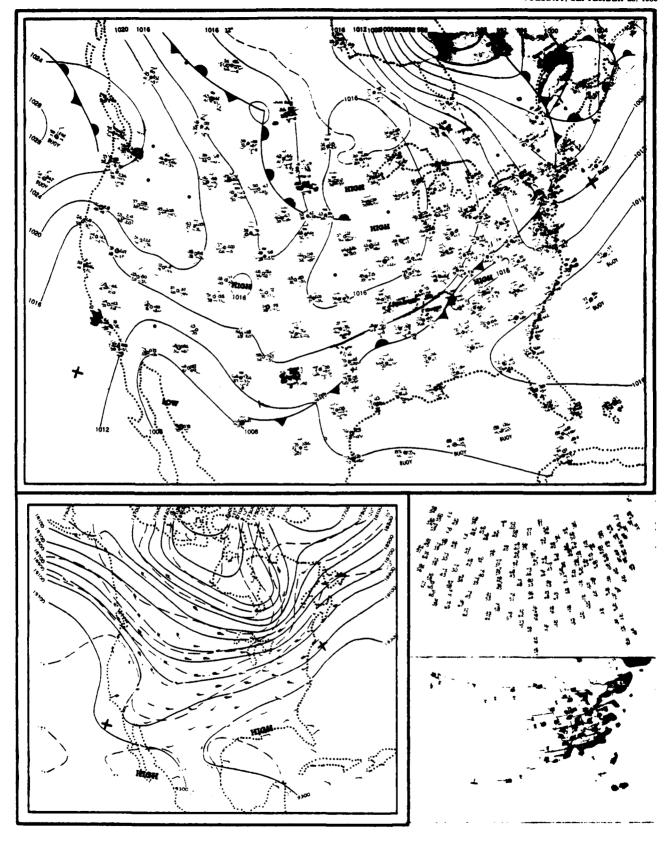
No laboratory calbration of the hot film sensors is made. The films are calibrated, in-situ, by comparing their output to that of the immediatly adjacent cup. Film calibration parameters are derived by comparing the one-half hour average mean and variance of the wind speed as determined by the two sensors.

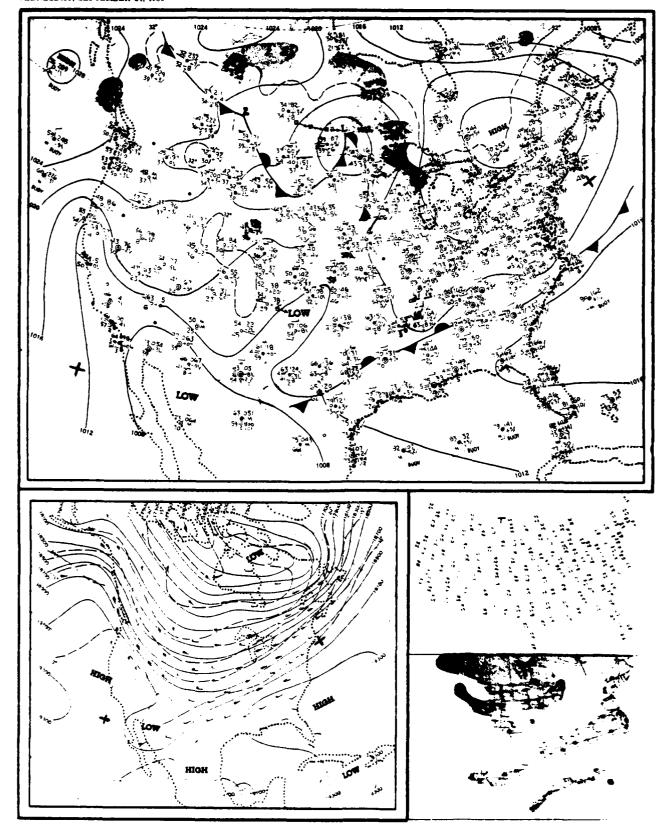
# APPENDIX B SYNOPTIC CHARTS

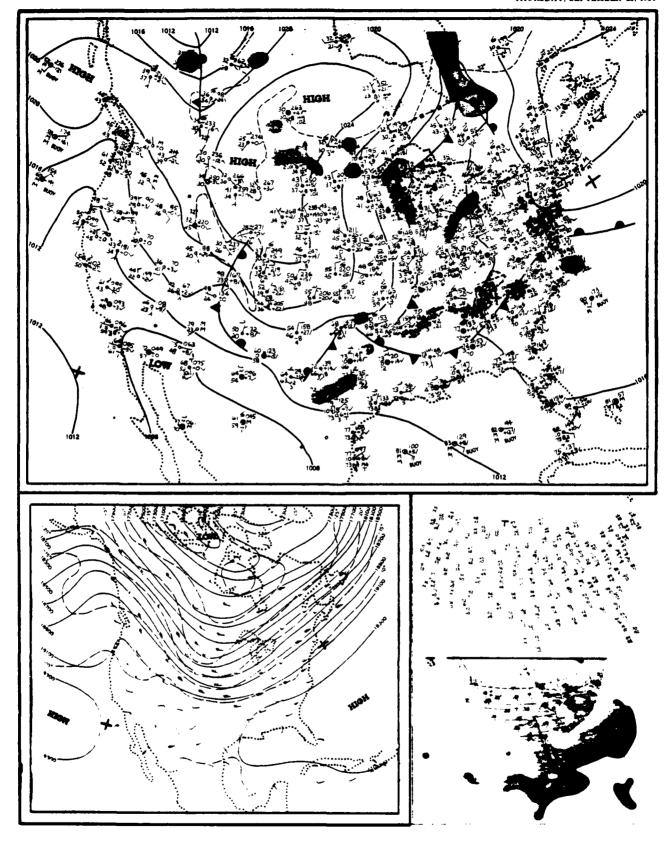


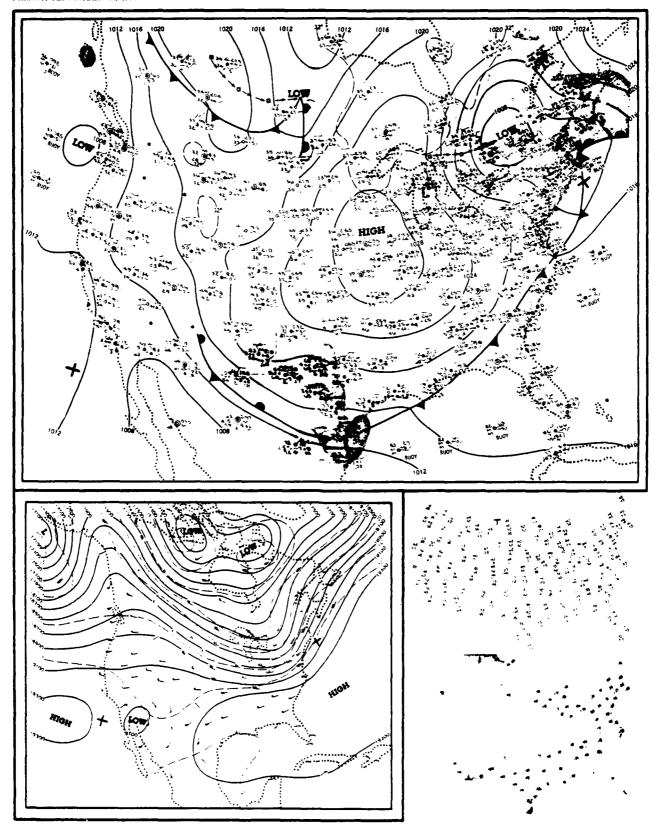






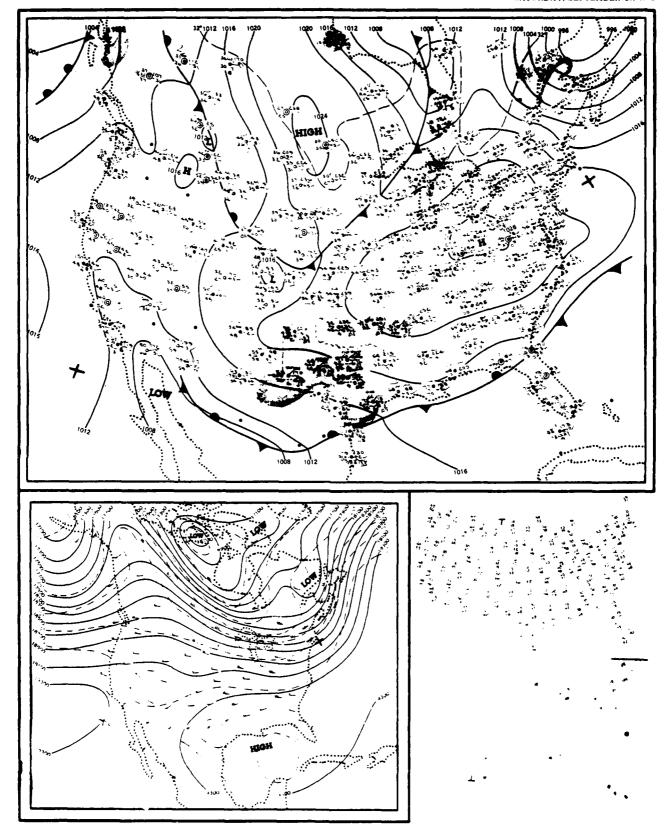




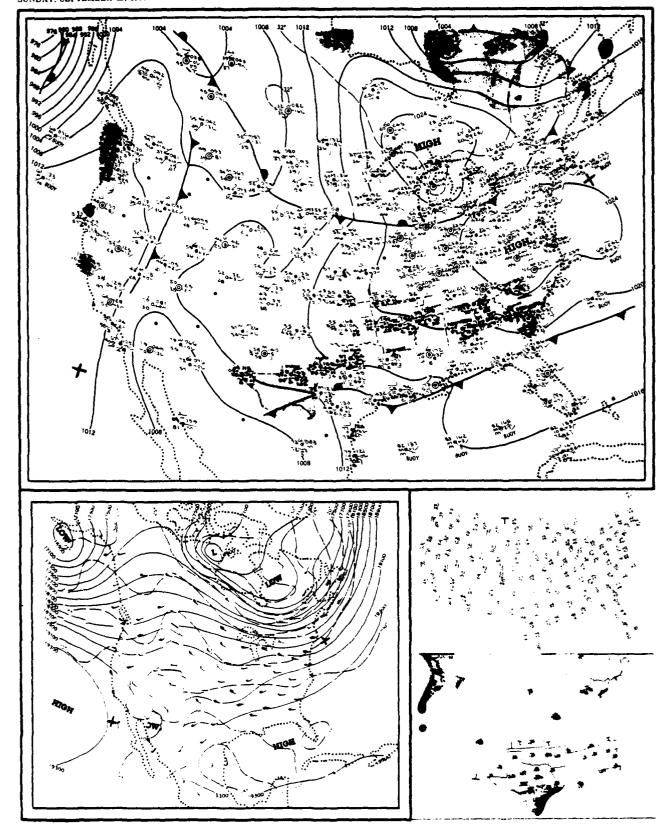


•

•

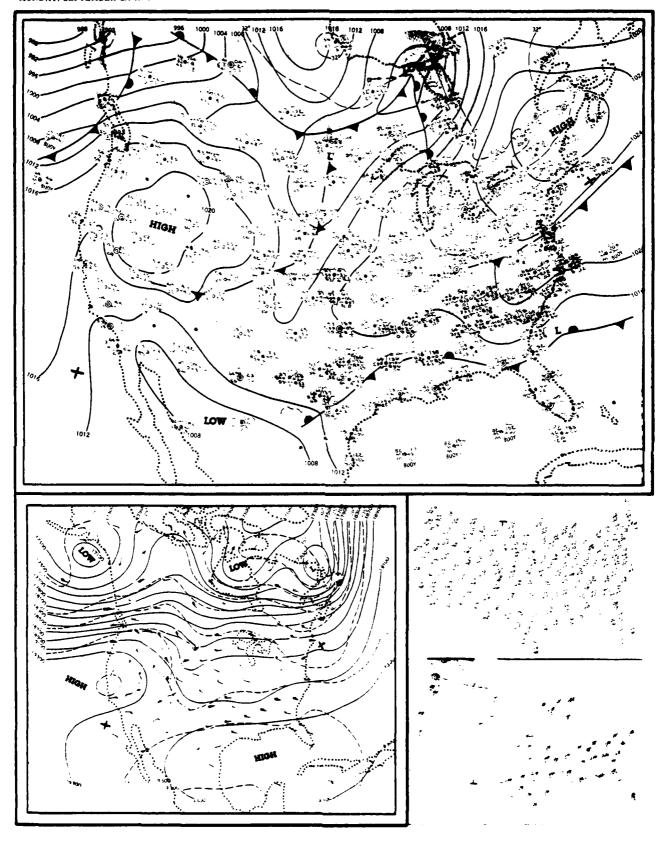


- --

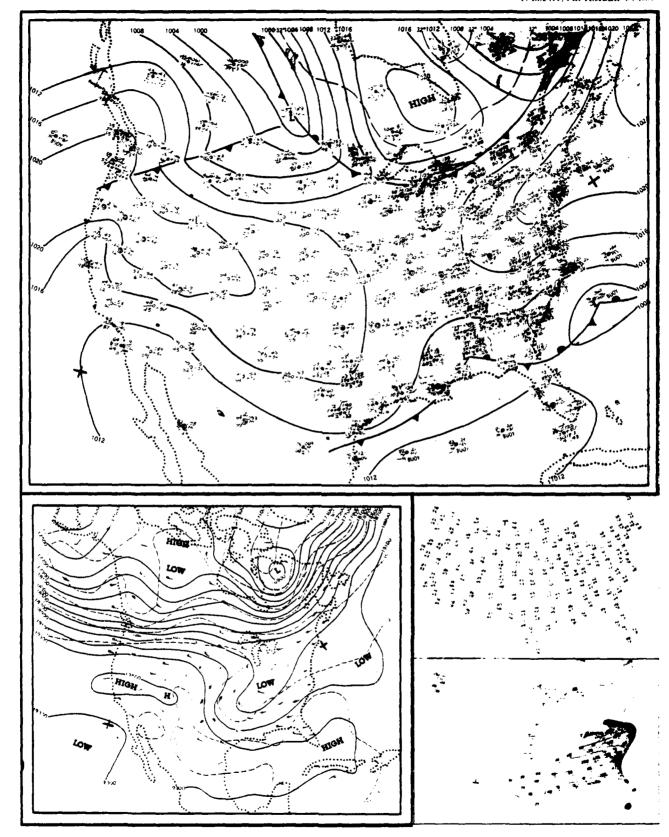


to a second second

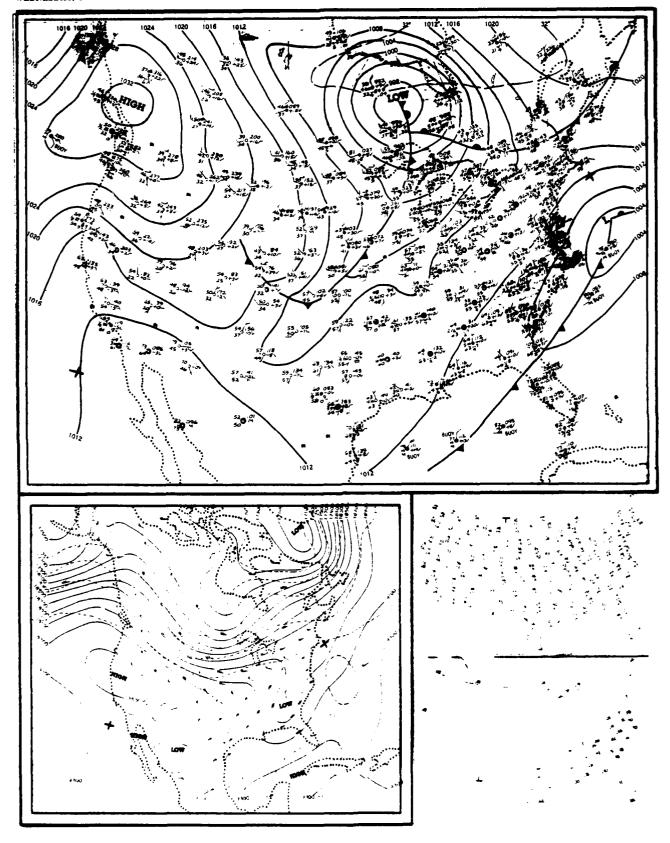
The state of the s



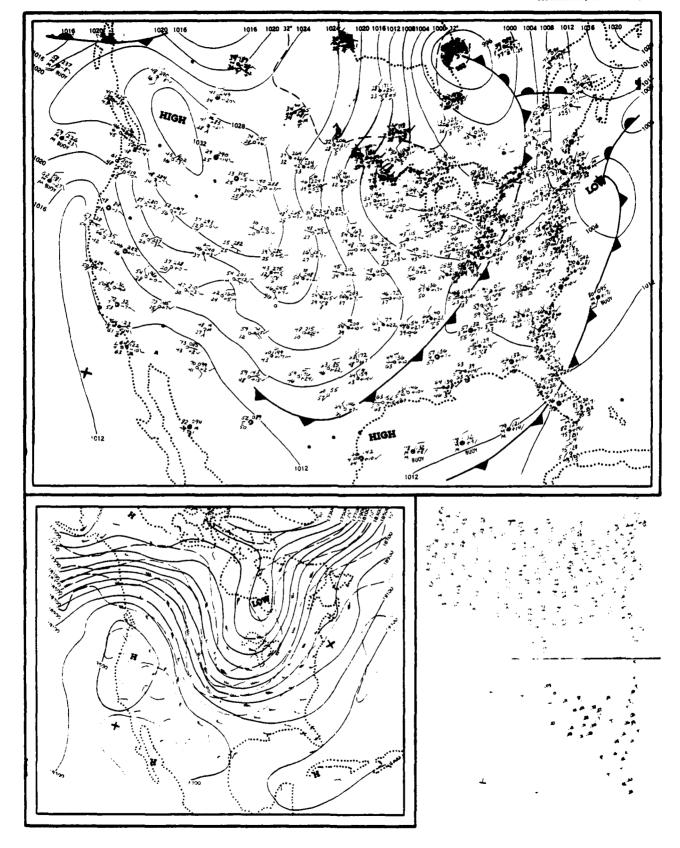
- - -

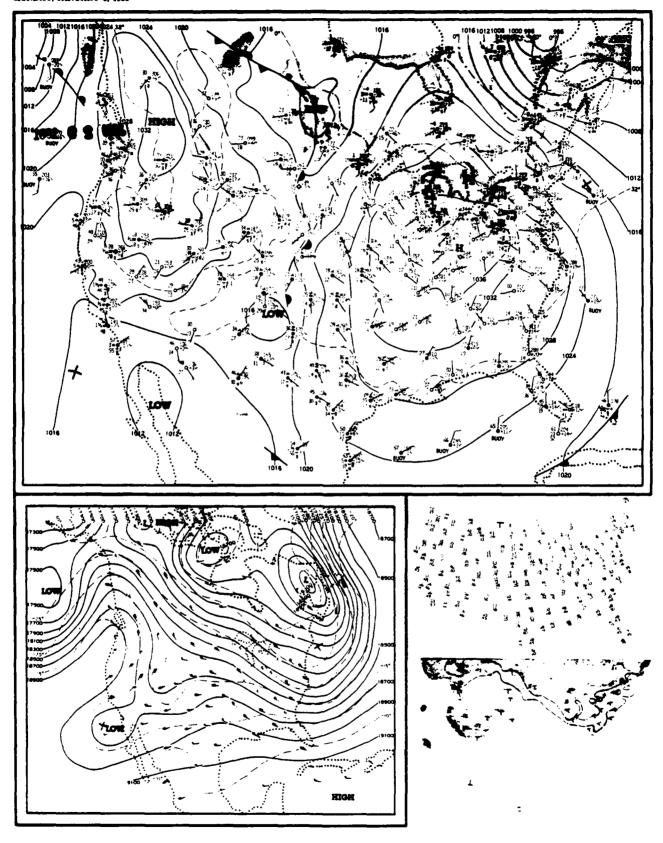


...

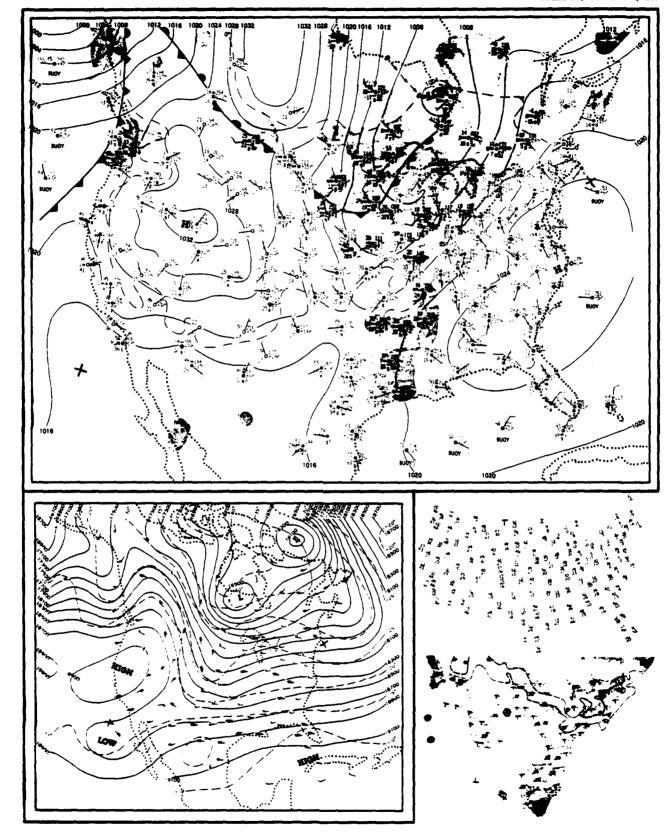


-

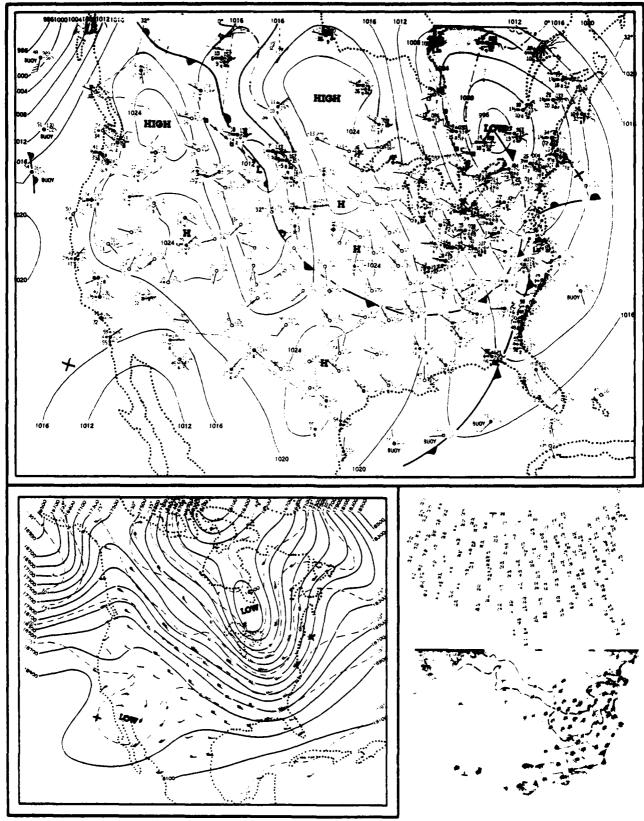


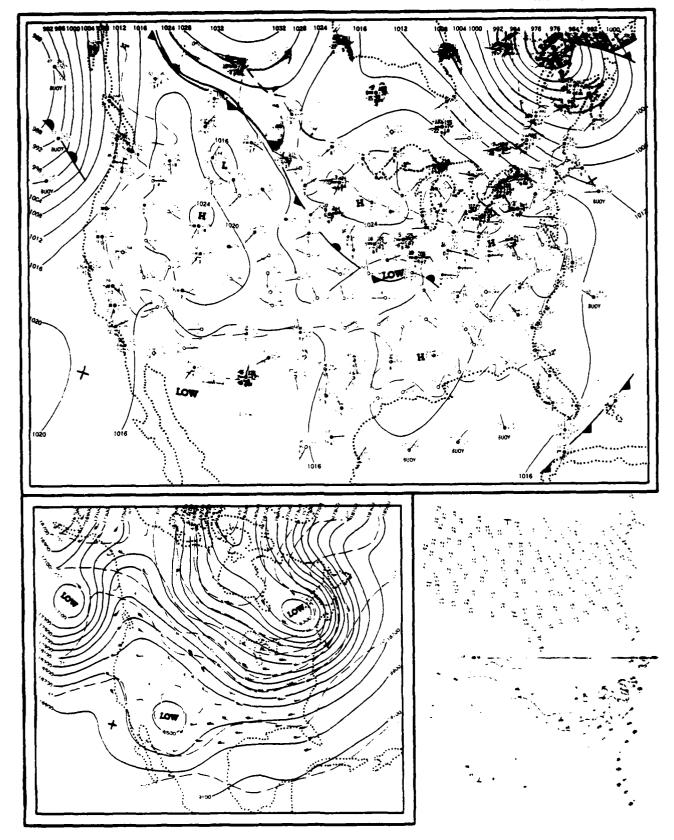


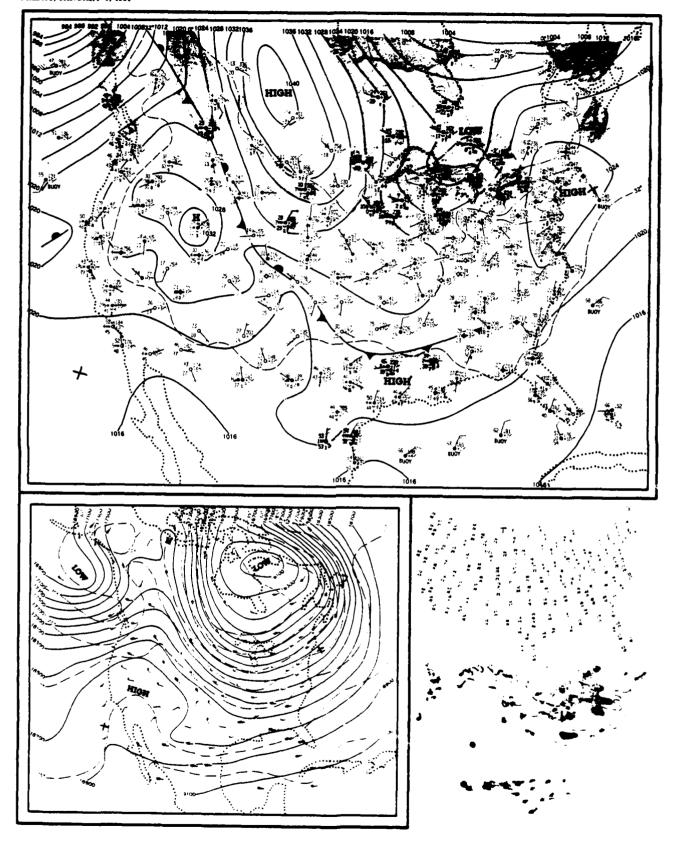
.

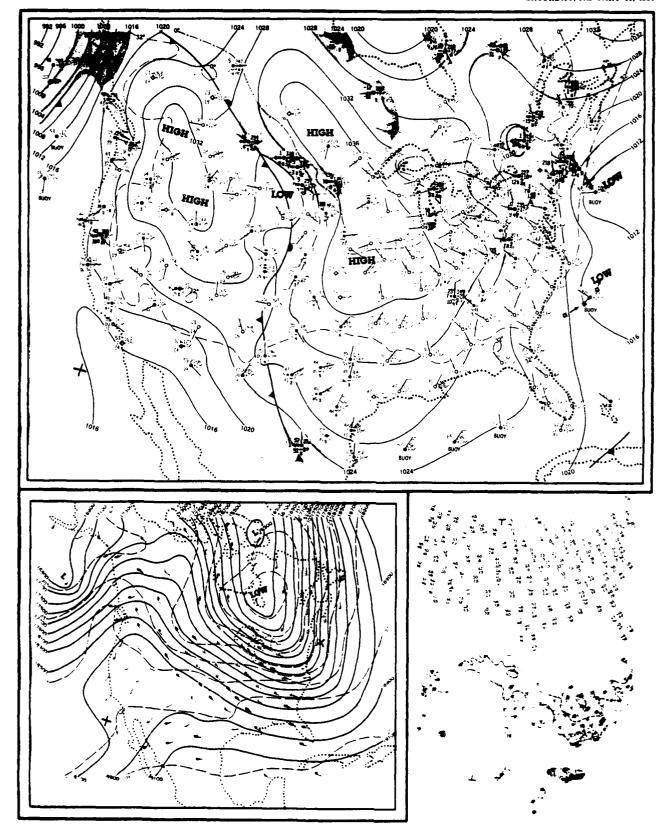


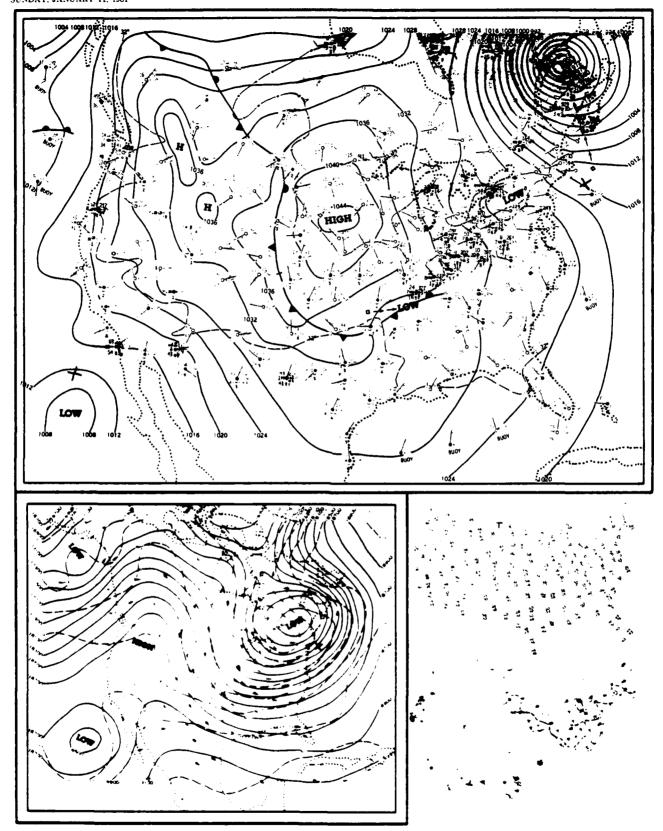
. ---

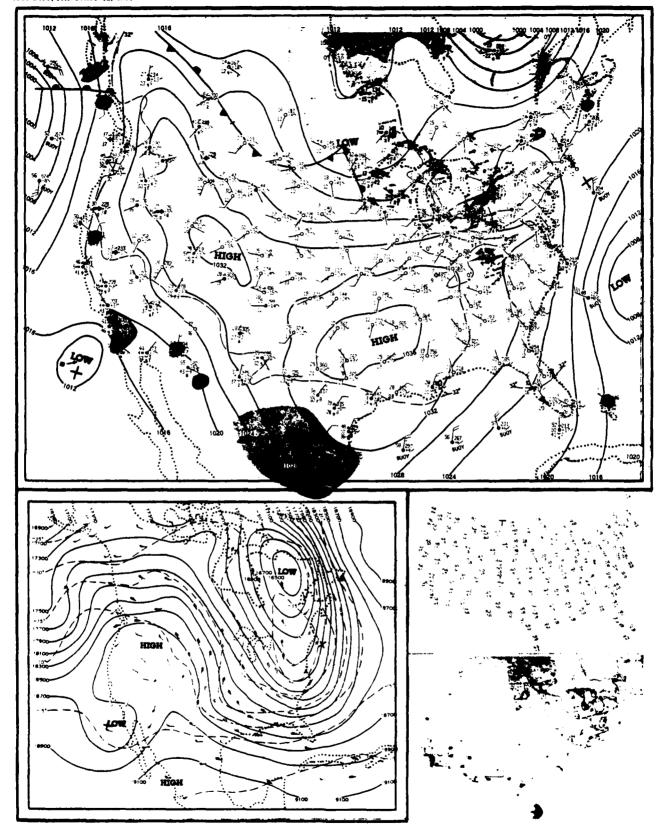


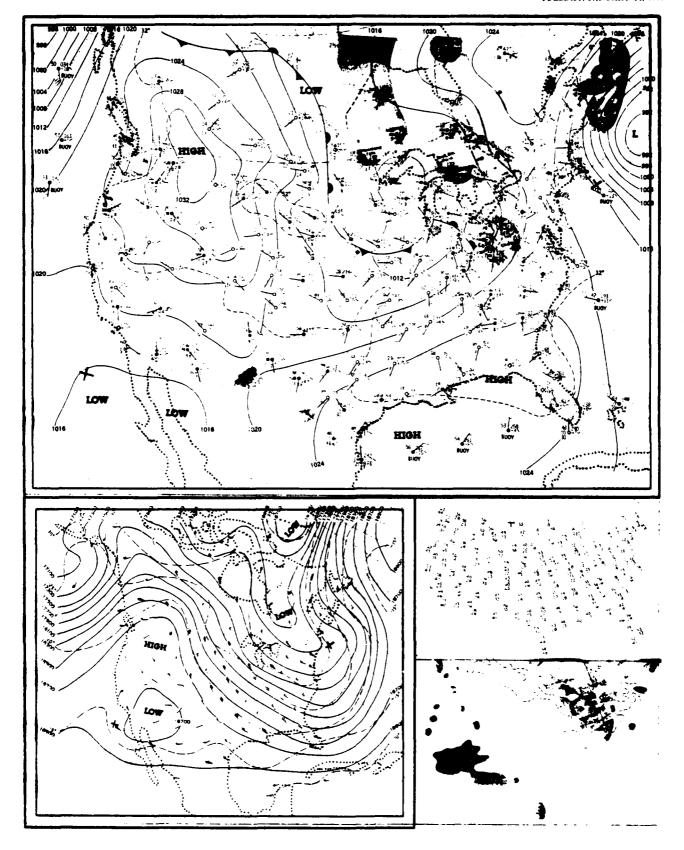


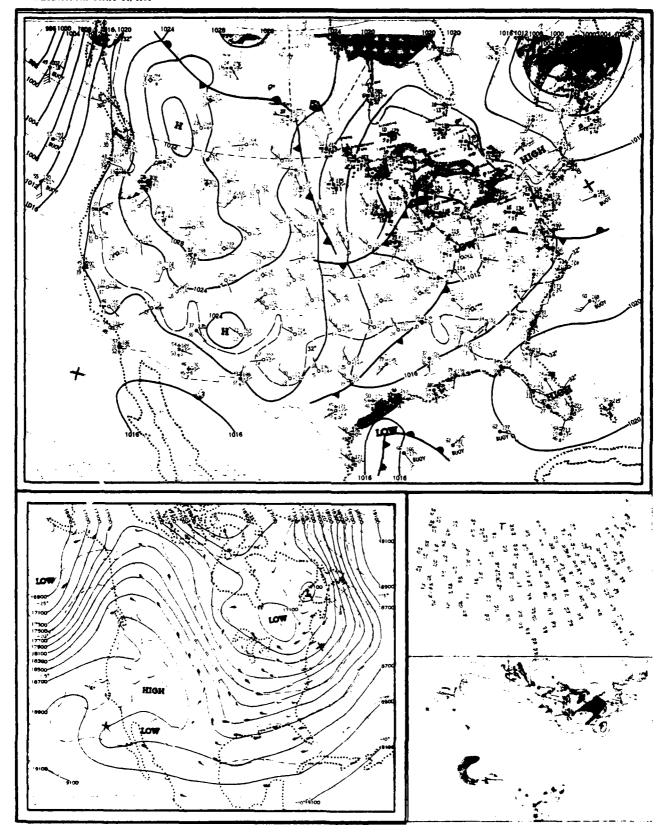


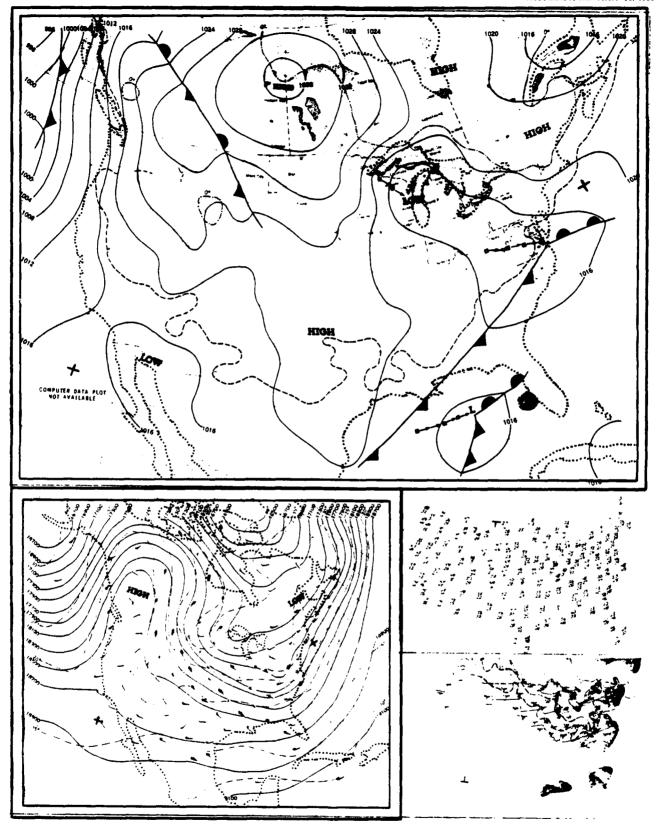




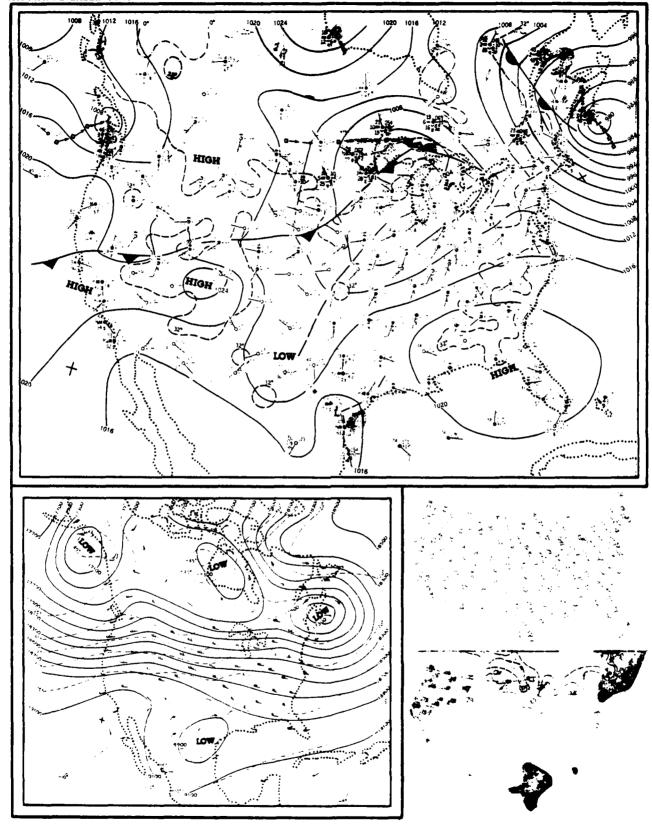


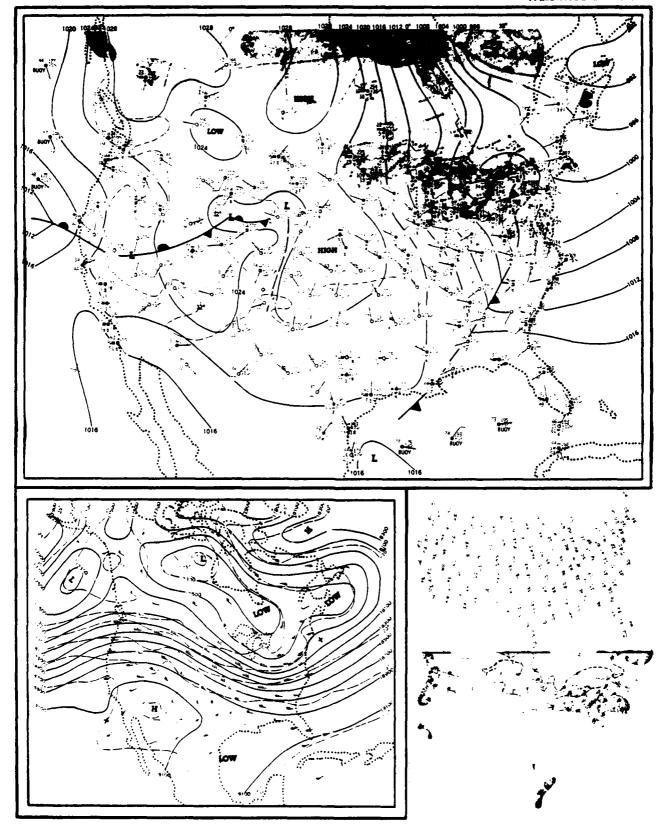


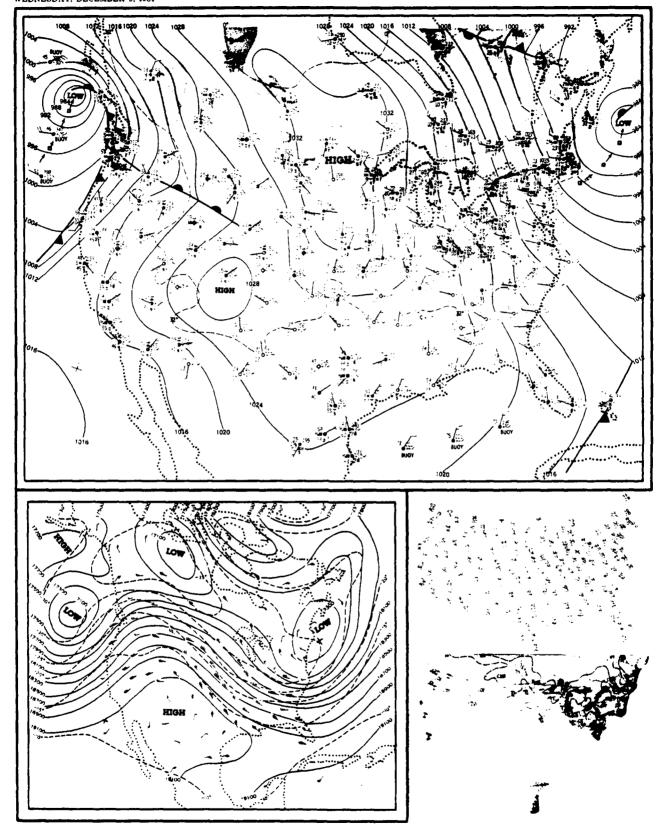


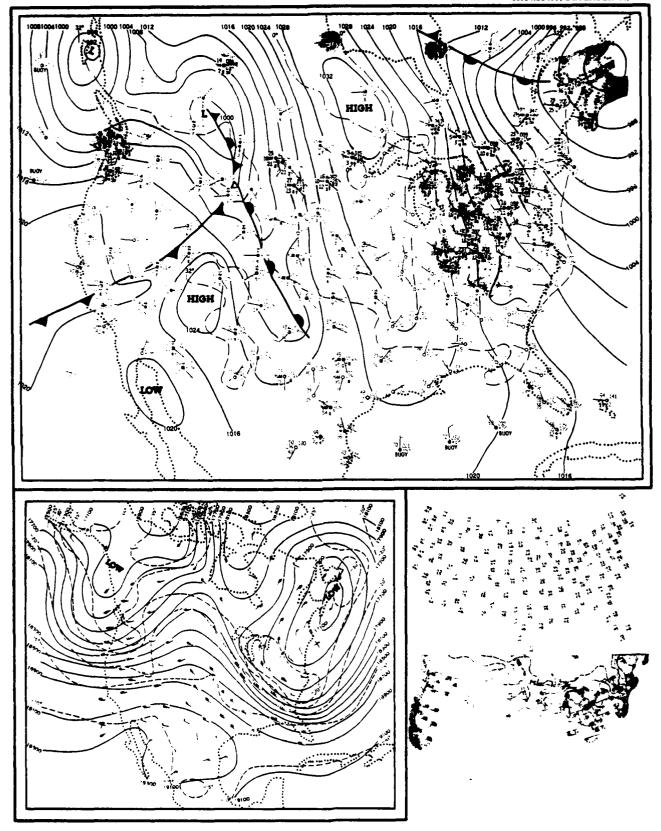


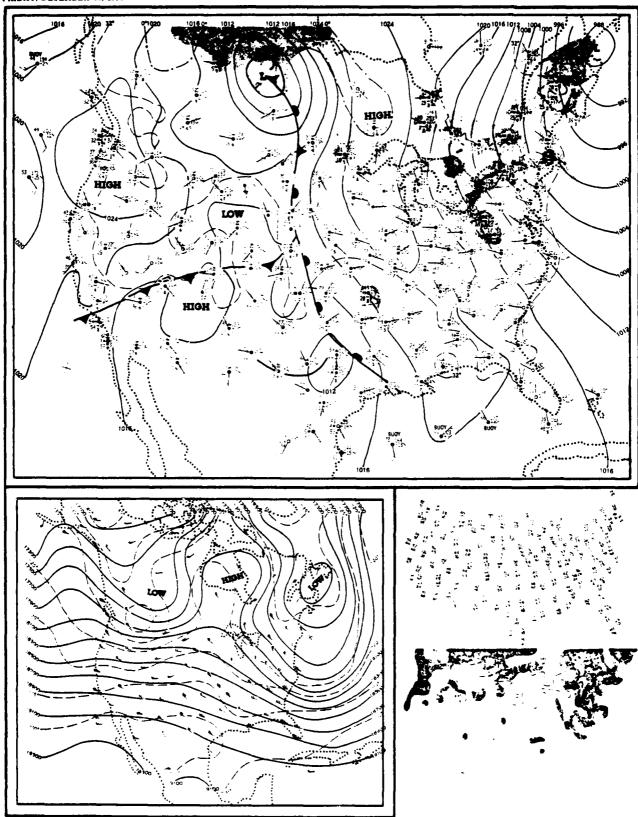
. . .

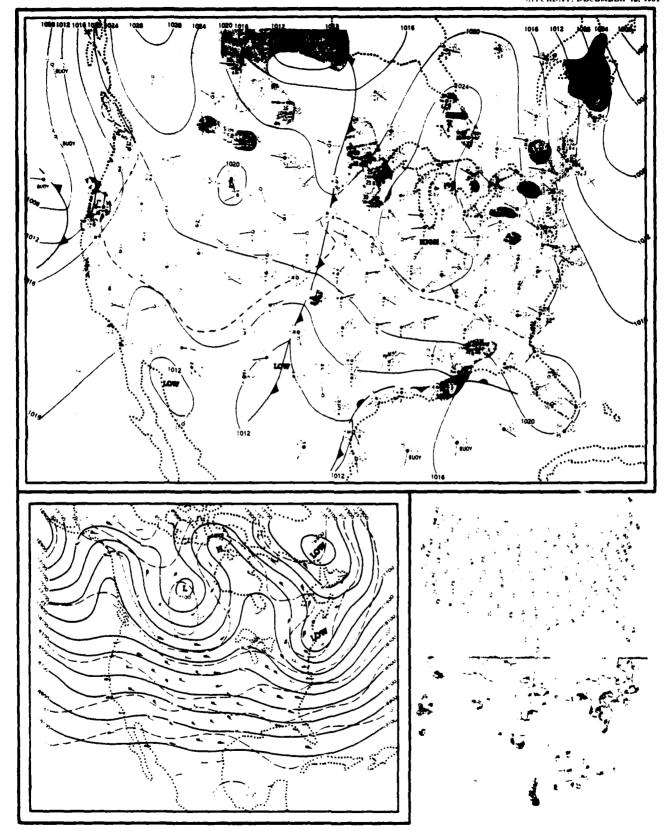




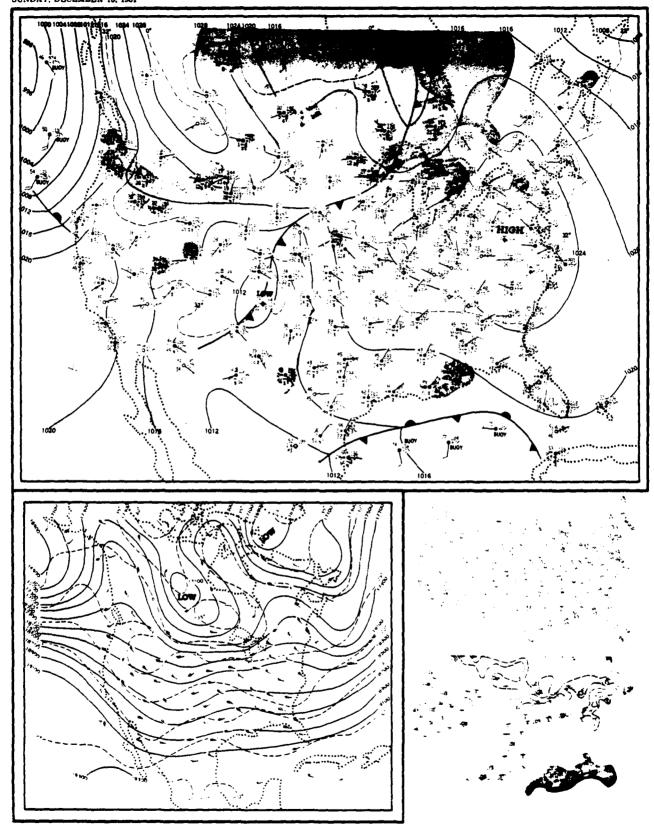


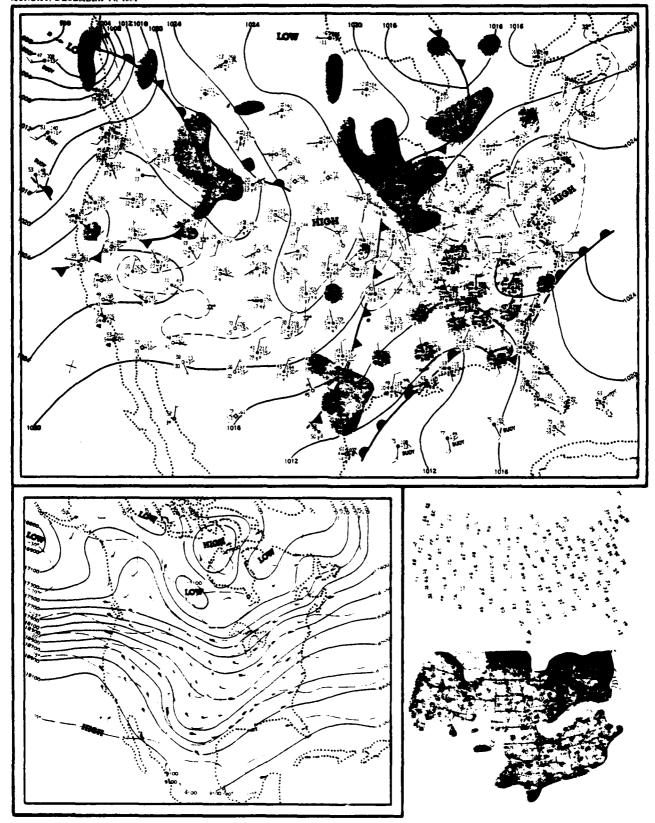




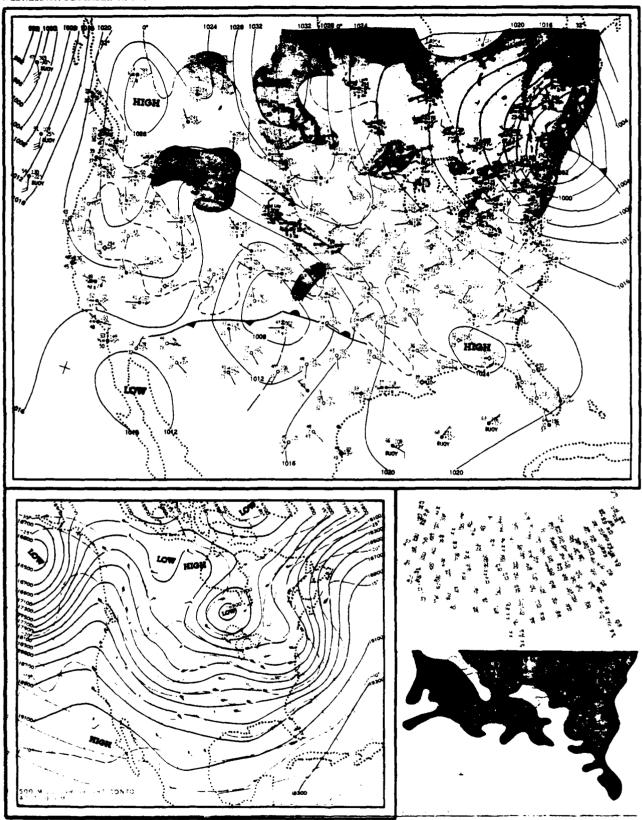


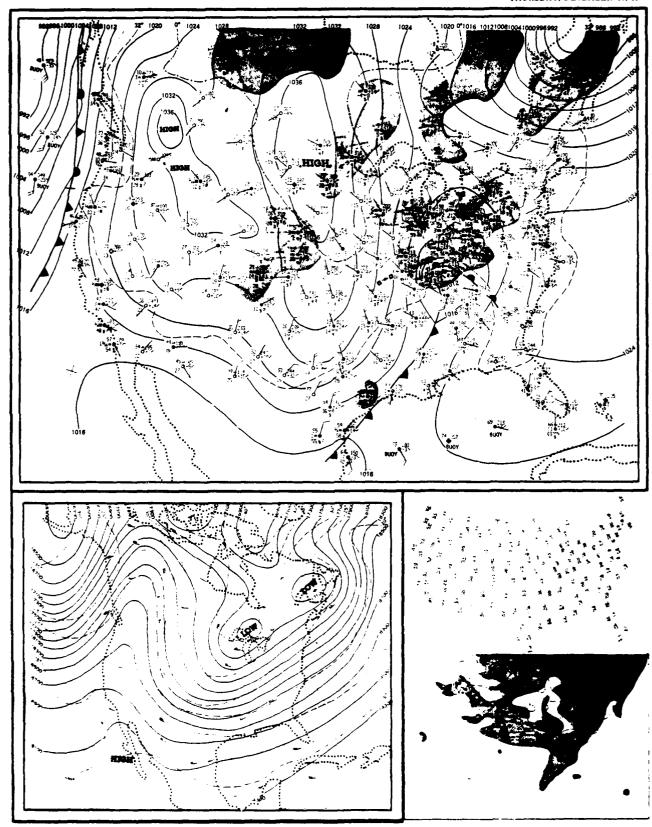
. . .

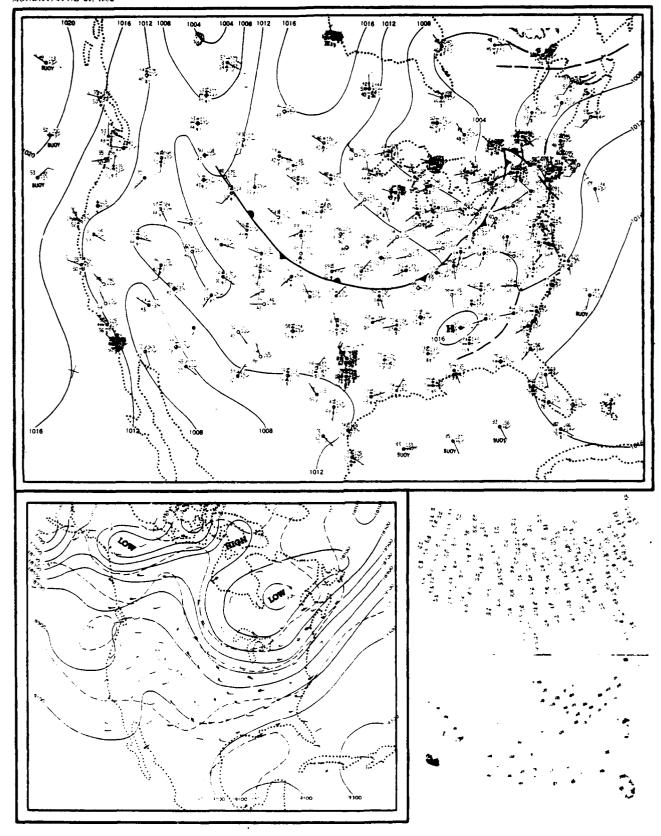


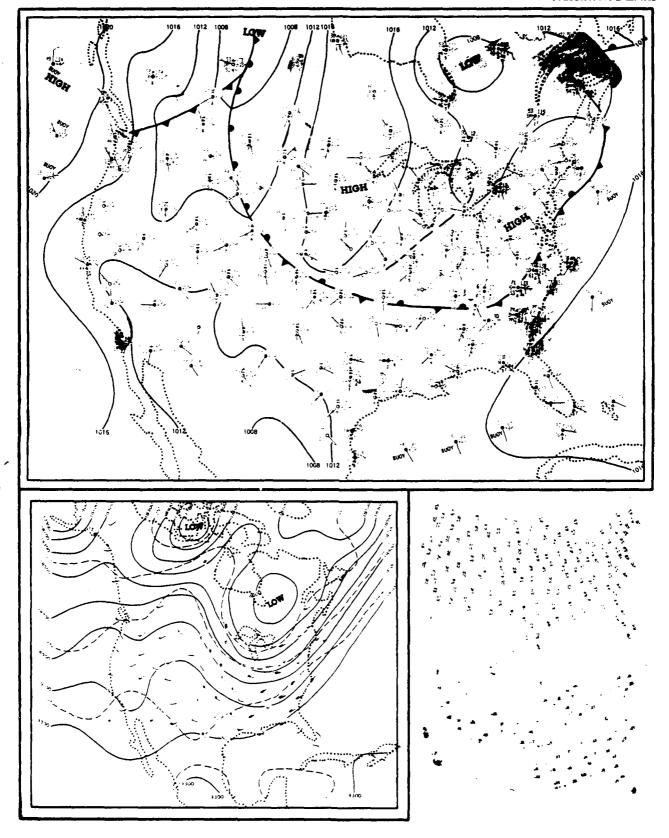


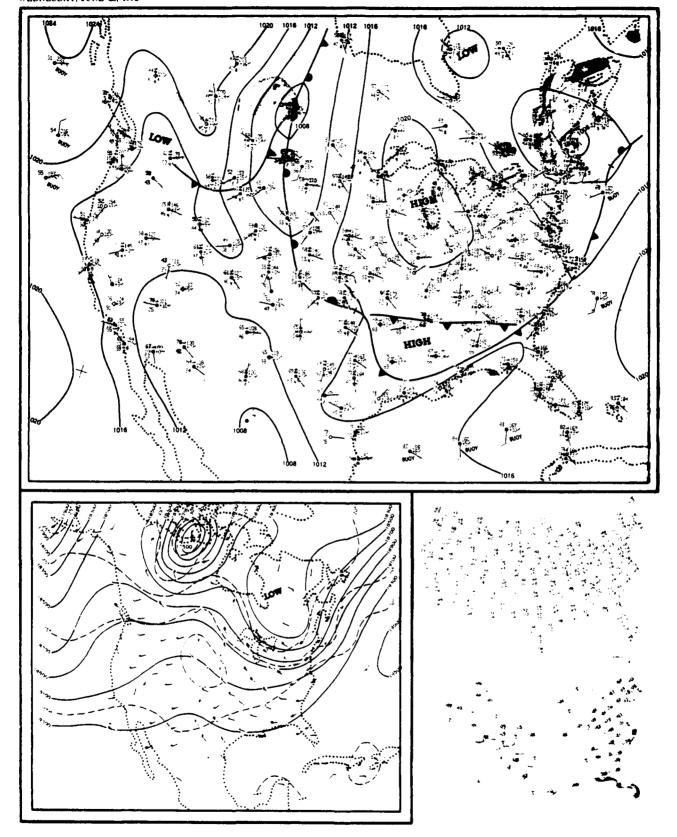


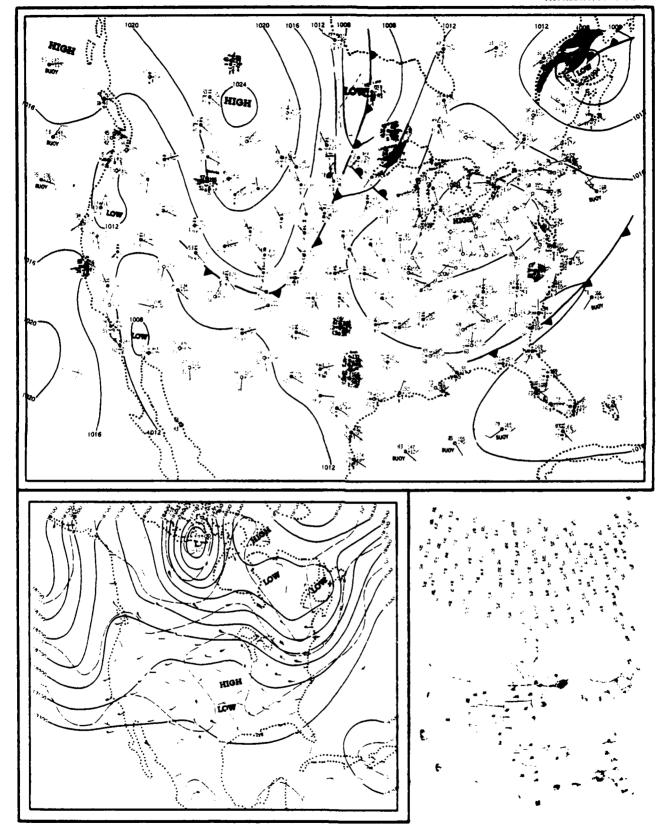


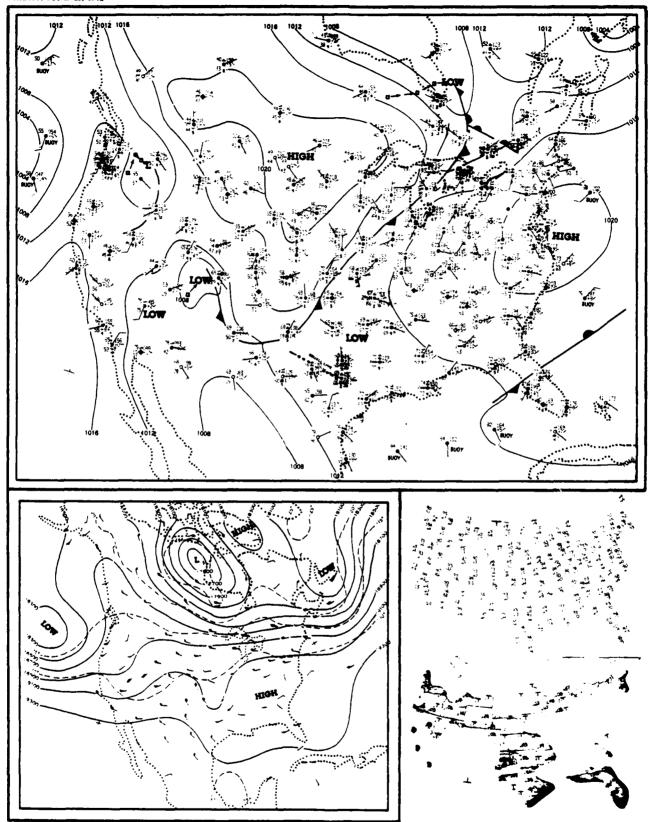


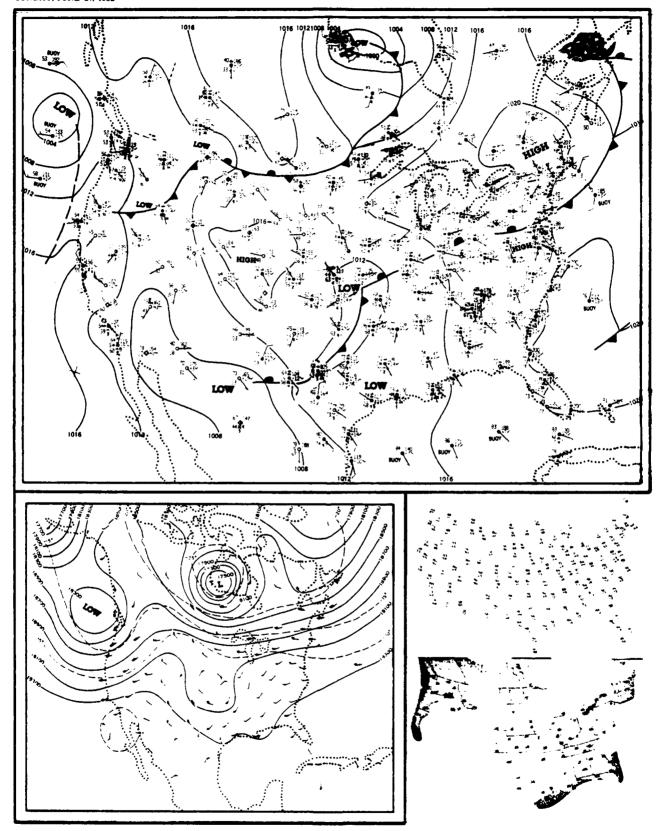


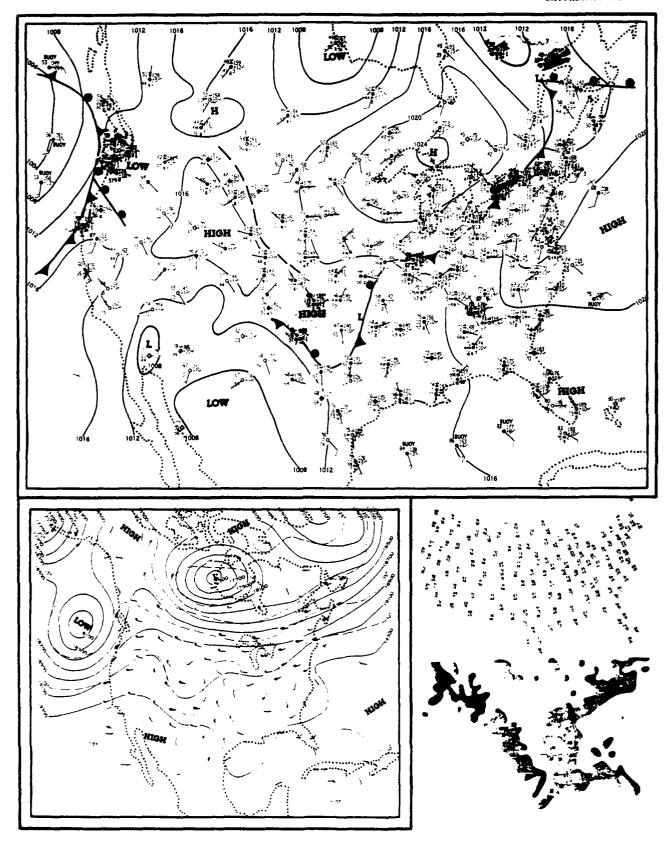


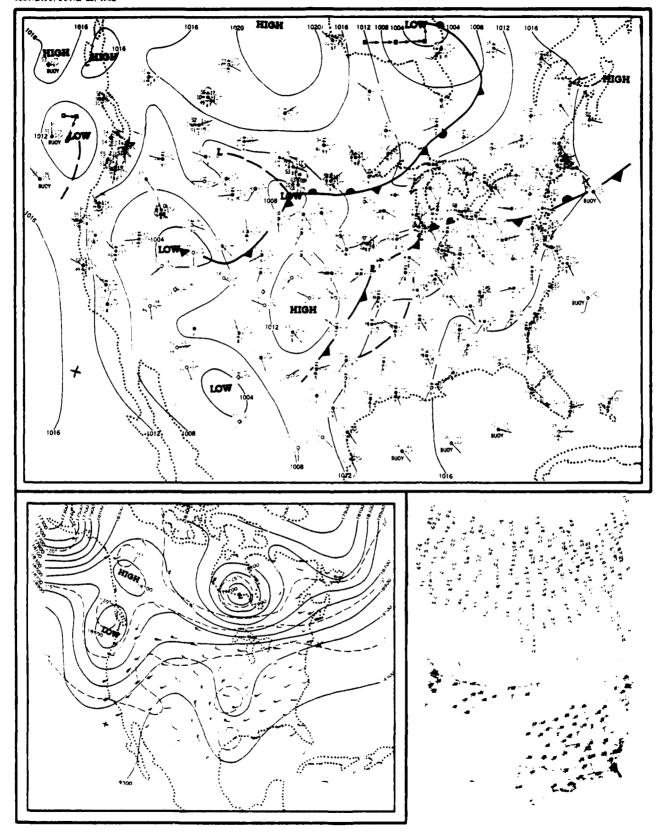




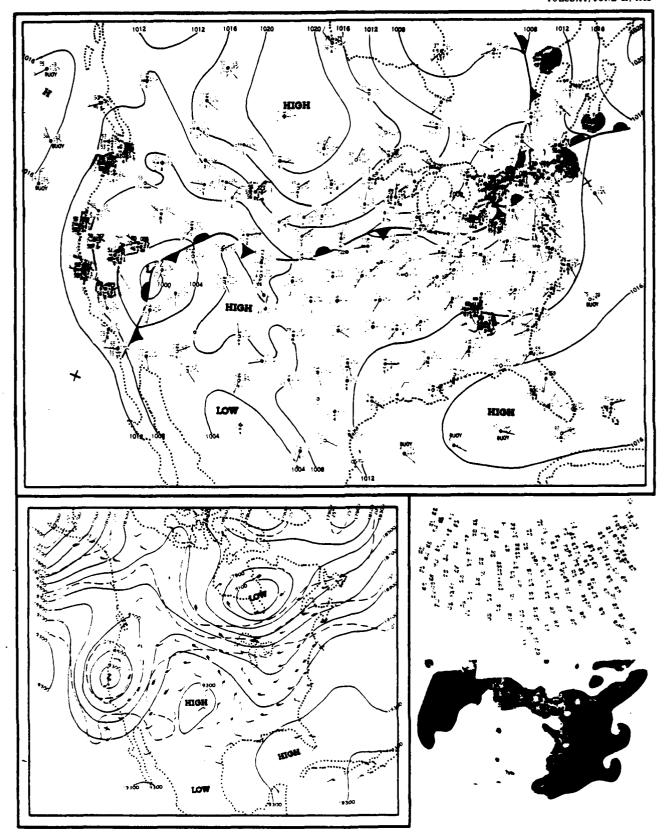


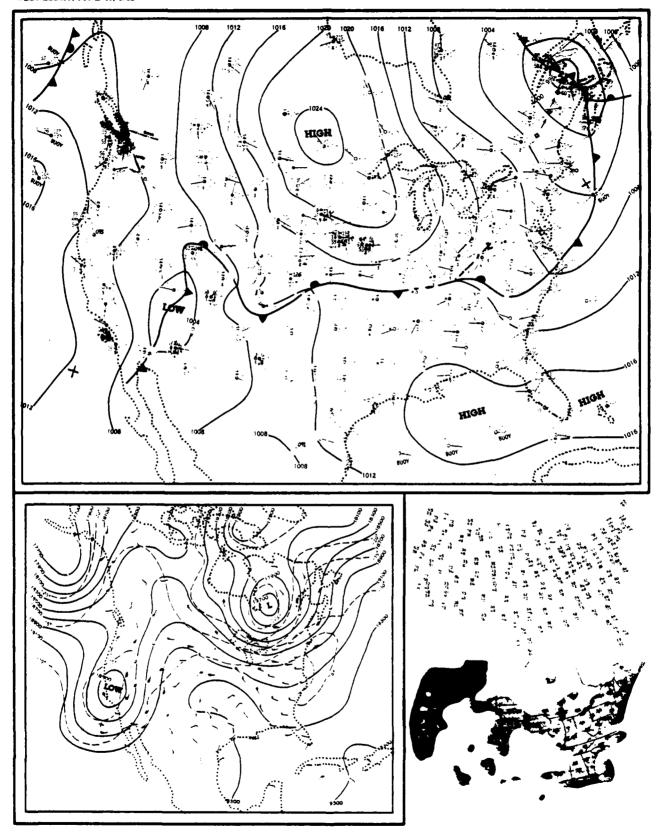


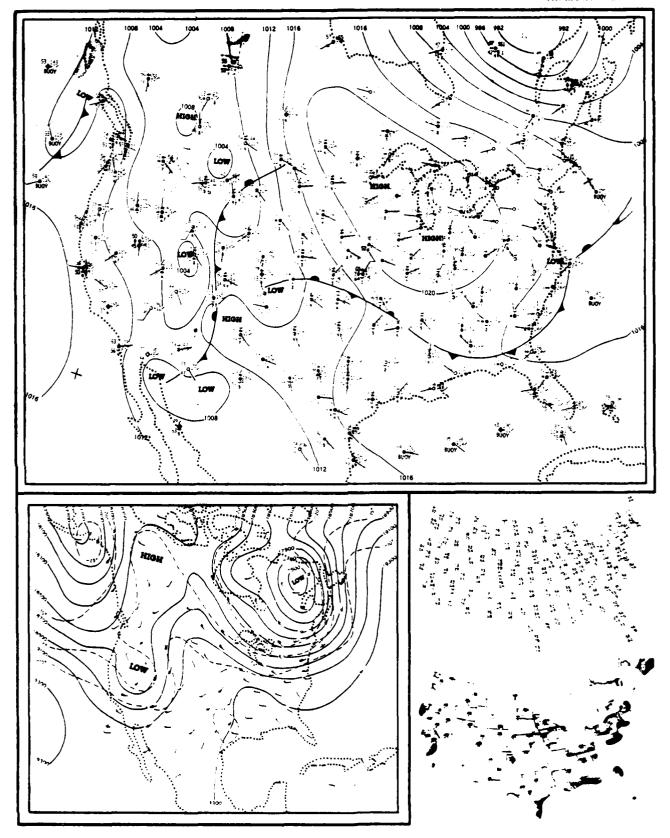




- ----







## REFERENCES

- 1. Schacher G.E., K.L. Davidson, C.A. Leonard, D.E. Spiel, and C.W. Fairall, "Offshore Transport and Diffusion in the Los Angeles Bight, NPS Data Summary" BLM-1: NPS-61-81-004; BLM-2: NPS-61-81-025; BLM-3: NPS-61-82-004.
- 2. "Data Submission for Offshore Tracer Study in Ventura County", AeroVironment, Inc. reprots, DP-80-056, D0-81-008, D0-81-026.
- 3. Brodzinsky, R., el al., "Central California Coastal Air Quality Model Validation Study: Data Compilations", Stanford Research International contractor reports (1982).
- 4. Schacher, G.E., D.E. Spiel, K.L. Davidson, and C.W. Fairall, "Comparison of Overwater Stability Classification Schemes with Measured Wind Direction Variability", NPS-61-82-002 (1982).
- 5. Schacher, G.E., C.W. Fairall, and P. Zanetti, Proceedings of First International Conference on Meteorology and Air/Sea Interaction of the Coastal Zone, p. 91, May 1981.
- 6. "Southern California Offshore Air Quality Model Validation Study, Synthesis of Findings", AeroVironment Report AV-FR-81/559 (1981).
- 7. deViolini, R., "Climatic Handbook for Point Mugu and San Nicolas Island, Part 1, Surface Data", Pacific Missile Range Report, PMR-TP-74-1 (1974)
- 8. "Terminal Forecast Reference Notebook", Vandenberg AFB report. DET 30, 2WS (1982).
- 9. "Naval Postgraduate School Shipboard and Aircraft Meteorological Equipment", NPS-61-80-017 PR, (1980).
- 10. Businger, J.A., J.C. Wyngaard, Y. Izumi, and E.F. Bradley, J. Atmos. Sci., 28, 181 (1971).
- 11. Davidson, K.L., T.M. Houlihan, C.W. Fairall, and G.E. Schacher, Boundary Layer Met. 15, 507 (1978).
- 12. Kondo, J., Boundary Layer Met. 9, 91 (1975).
- Wyngaard, J.C., Y. Izumi, and S.A. Collins, J. Optical Soc. Am. 61, 1646 (1971).
- 14. Kaimal, J.C., J.C. Wyngaard, D.H. Langen, D.R. Cote, and Y. Izumi, J. Atmos. Sci. <u>33</u>, 2152 (1976).

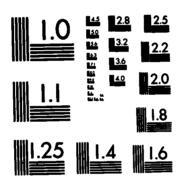
- 15. Shair, F., E. Sasaki, D. Carlan, G. Cass, W. Goodin, J. Edinger, and G. Schacher, "Transport and Dispersion of Airborne Pollutants Associated with the Land-Sea Breeze System", accepted Atmospheric Environment.
- 16. Willis, G.E., and J.W. Deardorf, Atmospheric Technology 7, 80 (1975).

## DISTRIBUTION LIST

		No	Ωf	Copies
1.	Defense Technical Information Center Cameron Station Alexandria, Virginia 22014		2	copies
2.	Library, Code 0142 Naval Postgraduate School Monterey, California 93940		2	
3.	Dean of Research, Code 012 Naval Postgraduate School Monterey, California 93940		1	
4.	Professor J. Dyer, Code 61Dy Naval Postgraduate School Monterey, California 93940		1	
5.	Professor R.J. Renard, Code 63Rd Naval Postgraduate School Monterey, California 93940		1	
6.	Mr. Dirk Herkhof Pacific Outer Continental Shelf Office Minerals Management Service 1340 W. 6th St., Room 200 Los Angeles, CA 90017		10	
7.	Professor K.L. Davidson, Code 63Ds Naval Postgraduate School Monterey, California 93940		2	
8.	Professor G.E. Schacher, Code 61Sq Naval Postgraduate School Monterey, California 93940		10	
9.	Dr. C.W. Fairall BDM Corporation, 1340 Munras St. Monterey, California 93940		2	
10.	Mr. Don Spiel BDM Corporation, 1340 Munras St. Monterey, California 93940		1	

ورسوا

CALIFORNIA COASTAL OFFSHORE TRANSPORT AND DIFFUSION EXPERIMENTS - METEORO. (U) NAVAL POSTGRADUATE SCHOOL MONTEREY CA G E SCHACHER ET AL. 06 DEC 82 NPS-61-82-007 F/G 4/2 AD-A123 582 5/5 UNCLASSIFIED END , FILMED



MICROCOPY RESOLUTION TEST CHART NATIONAL BUREAU OF STANDARDS-1963-A

11.	Mr. Sam Brand Naval Environmental Prediction Research Facility Monterey, CA 93940	1
12.	Dr. Warren Johnson SRI International 333 Ravenswood Ave. Menlo Park, CA 94025	2
13.	Mr. Stephen S. Wise Mobile Research and Development Co. Paulsboro, NJ 08066	]
14.	Dr. Gloria Patton Office of Naval Research 1030 E Green St Pasadena, CA 91106	3
15.	Dr. Warren Denner Science Applications Inc. 2999 Monterey-Salinas Hwy Monterey, CA 93940	נ
16.	Dr. Steven Hannah Principal Meteorologist Environmental Research & Technology Corp 696 Virginia Rd Concord, MA	]
17.	CDR S.G. Colgan Code 420 B Office of Naval Research 800 N Quincy St Arlington, VA 22217	1
18.	Mr. Thomas Rappolt 8950 Villa La Jolla Dr. Suite 2232 La Jolla, CA 92038	2
19.	MAJ Gary G. Worley Air Force Engineering and Services Center Tyndall Air Force Base, FL	1

20.	Dr. Ann Berman ERT	1
	7700 E. Araphoe Rd.	
	Englewood, CO 80112	
21.	C.H. Reheis Energy Resources Co., Inc. 3344 N. Torrey Pines Ct. La Jolla, CA 92037	1
22.	Dr. Donald L. Shearer TRC Environmental Consultants, 8775 E. Orchard Rd. Suite 816	Inc.

## 2-8 DT